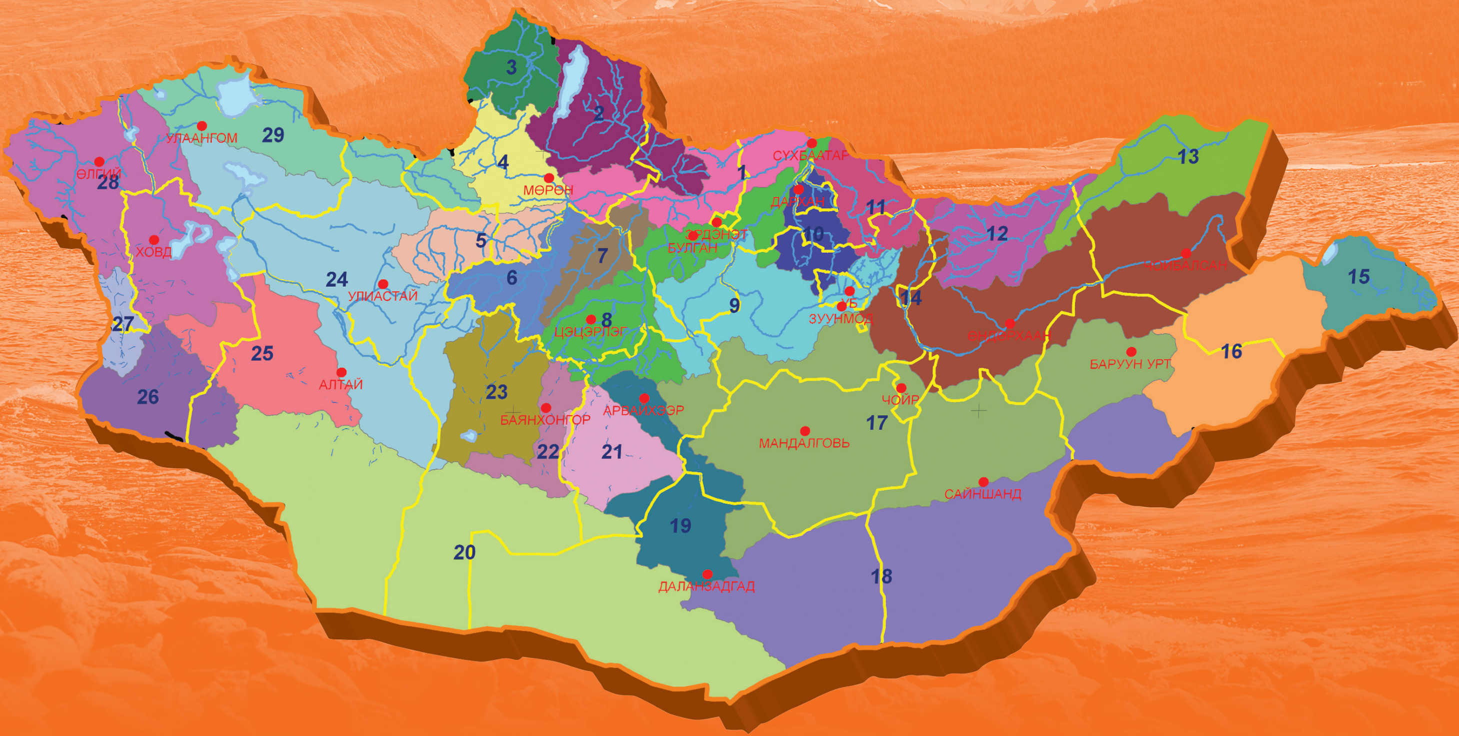
GOVERNMENT OF MONGOLIA

Kingdom of the Netherlands

INTEGRATED WATER MANAGEMENT NATIONAL ASSESSMENT REPORT

VOLUME II



GOVERNMENT OF MONGOLIA

MINISTRY OF ENVIRONMENT AND GREEN DEVELOPMENT

INTEGRATED WATER MANAGEMENT NATIONAL ASSESSMENT REPORT VOLUME II

Ulaanbaatar 2012

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This document was prepared within the framework of the "Strengthening Integrated Water Resources Management in Mongolia" project which was implemented at the Water Authority with support from the Government of The Kingdom of the Netherlands

INTEGRATED WATER MANAGEMENT NATIONAL ASSESSMENT REPORT VOLUME II

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ISBN 978-99962-4-538-1

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Foreword

Within the framework of the cooperation between the Governments of Mongolia and the Kingdom of the Netherlands, implementation of the "Strengthening Integrated Water Resources Management in Mongolia" project commenced on November 17, 2006 by the Water Authority (the former Government Implementing Agency for water) on the basis of the cooperation agreement signed by the former Minister of Nature and Environment of Mongolia and the ambassador of the Kingdom of the Netherlands in Beijing. The project implementing agreement was concluded on November 15, 2007 between the Ministry of Nature and Environment of Mongolia and the Ministry of Development Cooperation of the Kingdom of the Netherlands.

The renewed "Law on Water" approved by the Parliament in 2012 makes several references to river basins including: '... develop integrated water resources management plan for Mongolia and each water basin; the plan needs to be approved and implemented by the competent authority.'

The Mongolian Integrated Water Management Plan is one of the main outcomes of the Strengthening Integrated Water Resource Management in Mongolia project and aims to enforce the Mongolian Law on Water. At the same time, the Plan becomes the main water sector's planning and management document.

The main goal of the Mongolian Integrated Water Management Plan is to provide the planning for the integrated management measures to be taken by 2015 and by 2021 to meet the water needs for achieving the national development objectives. The measures include activities to prevent potential water scarcity, to protect water resources against pollution, to allocate and use water resources in the most efficient way, and to accumulate and increase water sources.

The planning principles of integrated management of water resource differ from planning in other sectors, because the unit of planning water management is the water basin rather than the administrative unit.

The principles of the Mongolian Water Sector's policy and planning have been laid down in the Mongolian Law on Water (2004). Within this framework and while enforcing this law, the former Ministry of Nature, Environment and Tourism resolved in 2010 that the Mongolian territory be divided into 29 basins and water management and planning be implemented on the basis of these basins.

Project experts and consultants jointly prepared technical and assessment reports on the Mongolian natural conditions, ecology, socio-economic development, land use, water consumption, water use, water demand, hydro-construction, waste water treatment and sanitation, legal environment for implementation of the integrated water resource management, the water sector's organizational structure, human resources, and the impact of climate change on water quantities and qualities of surface and groundwater resources, etc. The reports on all these issues comprise the basic data and information used in formulating the Mongolian Integrated Water Management Plan.

The reports are compiled in two volumes and are published together with the Mongolian Integrated Water Management Plan.

The first volume includes topics on assessment of water resources in Mongolia, surface water runoff modelling, impact of climate change on surface and groundwater resources.

The second volume includes topics on Mongolia's socio-economic development and its prospects, land use, water quality and ecology, water supply, water consumption and water use (as of 2008 and 2010 by each sector), water demand (as of 2015 and 2021 by each sector), current situation of hydro-constructions and the related measures to be taken in the future, waste water treatment and sanitation, legal environment that regulates the water management implementation, water sector's structure and organisation, water sector's human resources, etc, including conclusions and recommendations.

We sincerely hope that this set of documents prepared by the Strengthening Integrated Water Management in Mongolia project team will become the source book for future water studies and for formulating the Mongolian Integrated Water Resources Management Plans and provide policy makers, decision makers, experts in the water sector, researchers and students access to the latest water-related figures, data and information.

A mathematical model was developed for the first time to calculate water consumption, water use and water demand for 29 water basins using the latest data and information. The calculation forms the basis to precisely formulate the Integrated Water Management Plan for each basin. The model is an important tool as it creates the basic framework. The data used by the model can easily be updated to produce more accurate predictions of water demand when new data become available over time

On behalf of the National Water Committee and the project team, we would like to express our gratitude to the water sector's scientists, researchers, national and international consultants and the project's experts who cooperated in the preparation of the study reports that are compiled into the two volumes of this document. Special appreciation is due to the Ministry of Environment and Green Development of Mongolia for providing managerial and organisational support, and to the Government of the Kingdom of the Netherlands that through its Embassy in China provided the financial support to make this project possible.

Secretary National Water Committee and Chairman NWC Executive Board Ts.Badrakh

Project Senior Advisor IWRM Prof. Eelco van Beek

Acronyms and Abbreviations

ADB	Asian Development Bank
AFCCP	Agency for Fair Competition and Consumer Protection
ALACGC	Administration of Land Affairs, Construction, Geodesy and Cartography
CBA	Cost Benefit Analysis
CSM	Centre of Standardization and Measurement
CWWTP	Central Waste Water Treatment Plant
FGP	Family Groups Practices
GASI	General Agency for Specialized Inspection
GDP	Gross Domestic Production
GDT	General Department Taxation
GEI / IGE	Institute of Geo-Ecology
GIS	Geographical Information System
GNI	General National Income
GoM	Government of Mongolia
GWP	Global Water Partnership
HADCM3	Climate model from Hadley Institute
HDI	Human Development Index
IG	Institute of Geography
IMF	International Monetary Fund
IMH	Institute of Meteorology and Hydrology
IWRM	Integrated Water Resource Management
MAS	Mongolian Academy of Science
MCA	Millenium Challenge Account
MDG	Millennium Development Goals
MECS	Ministry of Education, Culture and Science (former)
MF	Ministry of Finance
MFALI	Ministry of Food, Agriculture and Light Industry (former)
MMRE	Ministry of Mineral Resources and Energy (former)
MNET	Ministry of Nature, Environment and Tourism (former)
MNS	Mongolian National Standard
MNT	Mongolian Tugrug
MoMo	German IWRM project
MRTCUD	Ministry of Roads, Transportation, Construction and Urban Development (former)
MSUA	Mongolian State University of Agriculture
MUST	Mongolian University of Science and Tech
NAMHEM	National Agency for Meteorology, Hydrology, and Environmental Monitoring
NDIC	National Development and Innovation Committee
NEMO	Netherlands-Mongolia Trust Fund for Environmental Reform

NGIC	National Geo-Information Centre for Natural Resource Management
NGO	Non-governmental Organization
NSO	National Statistical Office
NUM	National University of Mongolia
O&M	Operation and maintenance
OSNAAG	Housing and Communal Services Authority
PPP	Public Private Partnership
PUSO	Public Urban Services Organization
RB	River Basin
RBA	River Basin Administration
RBC	River Basin Council
RBO	River Basin Organization
SDUB	Statistical Department of Ulaanbaatar
SGKhM	State Great Khural of Mongolia
SPC	State Property Committee
TPP	Thermal Power Plant
TRB	Tuul River Basin
UB	Ulaanbaatar
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
USUG	Water Supply and Sewerage Authority of Ulaanbaatar
WA	Water Authority
WB	World Bank
WD	Water Demand
WHO	World Health Organization
WMO	World Meteorological Organisation
WPI	Water Poverty Index
WSS	Water Sanitation System
WTP	Willingness to Pay
WWF	World Wildlife Fund
WWTP	Waste Water Treatment Plant

Part 1.
SOCIO–ECONOMIC DEVELOPMENT OF MONGOLIA

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1. Introduction

The environment is a natural resource base, a set of natural goods (e.g. landscape), a waste absorption system (sink), and a life support system to us. We extract raw materials (e.g. water) from the environment, process these and dispose of large amounts of degenerated and/or chemically transformed resources (wastewater) back into the environment, in order to provide goods and services or wealth. In this document, we specifically look at water and water related resources. In the process of extracting, processing and consuming water, and disposing of wastewater two items are important:

- All resource extraction, production and consumption results in a waste outflow, equal to the resource inflow in terms of matter and energy;
- It is not possible to recycle the waste flow for 100% to enter the resource flow again.

At the same time, most water resources are provided free of charge. This results in individual consumers trying to maximize its use, whereas society as a whole pays for its loss or depletion.

Water availability in Mongolia is constrained by low and unreliable precipitation and high evaporation rates. Some years ago, almost half of the population received water from sources regarded as unsafe, such as unprotected wells, rivers, run-off or snow and about 35 percent of the total population used water from a centralized supply system (Apartment and Ger area). There is evidence that many small lakes, ponds, rivers, creeks and springs have dried up or diminished in size and water tables have declined in recent years due to human activities, climate variability and possibly climate change. Moreover, effluent from households, factories, tanneries, processing plants, waste disposal sites and road runoff is polluting many of Mongolia's rivers. Sewerage coverage is one of the lowest in Asia, which is causing widespread contamination of surface and groundwater both in Ulaanbaatar and secondary cities.[1] This situation calls for drawing up an IWRM plan.

Part of the IWRM plan is a socio-economic analysis. The socio-economic analysis' main objectives are the analysis of the current socio-economic situation of Mongolia; the definition of important water uses; the water demand analysis; and analysis of the trends in the water sector. The following tasks have been carried out:

I. Data collection and analysis;

II. Analysis current socio-economic situation;

III. Analysis of the national economy, investment and financing policy of Mongolia, including a review of foreign investments, donor aid and existing loans in the water sector at the national and the River Basin level;

IV. Assessment of all collected data relevant to the water sector related to the economic development of Mongolia and the Orkhon-Tuul River Basin;

V. Economic assessment of water resources at national and Orkhon-Tuul River Basin level;

VI. Definition of all required economic figures, projections and indicators for the design of alternative strategies for the IWRM plans;

VII. Assessment of data concerning water prices and water use fees for all sectors and translation of strategies to future projections of water fees and prices.

[1] UNDP Mongolia Common Country Assessment, 2005

The socio-economic analysis will help to work out the IWRM plan, to set up a water management policy and to define necessary activities for the action plan in order to achieve the Mongolian socio-economic development goals. Moreover, the analysis will support the development and implementation of economic and financial mechanisms for the water sector.

2. Data Collection and Sources

For the analysis of the socio-economic development of Mongolia, official documents, reports, statistical information etc. from secondary sources like the World Bank (WB), Asian Development bank (ADB) and other international organizations, the National Statistical Office and other Government institutes and NGOs were collected. In addition, primary datanwas used through data collection by means of questionnaires and interviews. Water use, payment and tariff datanwere collected from official sources as well as from water users through interviews. A list of all collected data and information is presented in Annex 1. Table 1 shows a summary of the data sources and type of data used.

Table 1. Data sources used for the socio-economic analysis

Type of data	Source	Confirmation
Administration	Mongolian National Atlas	Mongolian National Atlas, MAS, IG 2009
Population	NSO, www.statistic.mn,	Statistical Yearbooks, NSO,UB 2007-2011, Population and Housing Census-2010 main results
Macroeconomic	WB, IMF. NSO, MF, MFALI, www.pmis.gov.mn www.statistic.mn, other related web sites	Statistical Yearbooks, NSO,UB 2007-2011, Policy documents of GoM
Agriculture	NSO, MFALI, MF, www.pmis.gov.mn www.statistic.mn,	Statistical Yearbooks, NSO,UB 2007-2011, Agriculture, NSO,UB 2007-2010, Budget Project of Mongolia 2009-2011, MoG, 2008
Industry	NSO, MFALI, MF, www.pmis.gov.mn www.statistic.mn	Statistical Yearbooks, NSO,UB 2007-2011, Budget Project of Mongolia 2009-2011, MoG, 2008
Water tariff and fee	MF, WA, ALACGC, USUG, PUSO, OSNAAG, related web sites, government officers	Local Governments, USUG, PUSO and OSNAAG's Orders

By January 2011, data collection was completed. The base year used for the methodology of the IWRM framework in Mongolia is 2008.

3. Methodology

An IWRM approach is new in Mongolia. Therefore, international experience, existing methods, guides, and handbooks of GWP, WB and other International organizations have been used for the socio-economic analysis of Mongolia. Especially "the Economic and the environment guide" of the Water framework Directive of the European Union was useful.

The socio-economic analysis comprises an analysis of the current situation and an assessment of potential economic approaches for developing the future IWRM situation, both on National level and on River Basin level.

Analysis current situation

The main purpose of the situation analysis is the definition and assessment of the current situation, main stakeholders and issues, development trends by economic development stage (by 2015, 2021). A situation analysis consists of the following phases:

- Scope definition, i.e. the boundary of the area taken into account in the base case;
- Analysis of the current socio-economic and ecological situation on national and River Basin level;
- Forecast of development trends;
- Definition of the main issues in relation to water;
- Determination of the main stakeholders;
- Assessment of interests, power, and potential resources of the stakeholders and its importance in relation to other stakeholder groups.

Economic analysis

The items taken into account in the economic analysis in the field of water management were the following:

- Definition current situation and actual issues of water use on the national and river basin level;
- Setting up realistic water use and protection goals, which will support sustainable socio-economic development, based on limited economic resources for the water sector;
- Developing scenarios and relevant measures and activities for achieving the goals, which is also input into the cost effectiveness analysis;
- Assessment of impacts of the scenarios of socio-economic development in order to identify the scenario(s) that best support sustainable development;
- Identification and development of economic and financial instruments that support the selected scenarios.

Figure 1 shows how the economic elements relate to the overall IWRM project elements.

Source: Economics and the Environment –
The Implementation Challenge of the Water Framework Directive, 2003

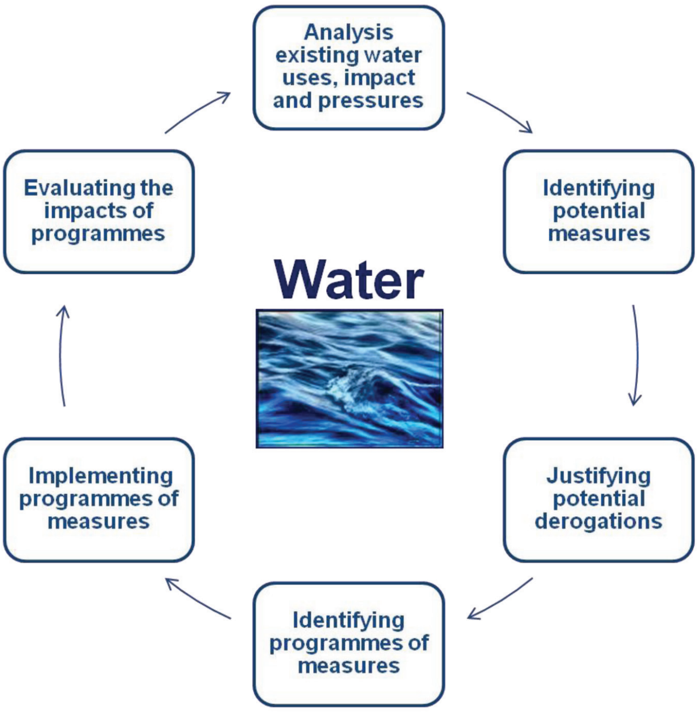


Figure 1. Economic elements are linked and must be integrated

The economic analysis consists following stages: [55]

- Analysis of existing water uses, impact and pressures:
  - Economic importance of water uses and water sectors investment based on the analysis of the current socio-economic situation;
  - Assessment existing water pricing system;
  - Trends in water supply and demand;
  - Economic valuation of water;
- Identification of potential measures:
  - Assessment of unitary costs of measures present in the scenarios;
  - Assessment of effectiveness of measures;
  - Selection of potential measures based on cost effectiveness and cost benefit analysis;
- Justification of potential derogations:
  - Assessment of costs and benefits of packages of measures;
  - Identification of measures that lack investment;
  - Assessment of cost recovery levels and definition of possible cost recovery levels;
  - Proposal for cost recovery levels for the derogations and definition of timing of justification;
- Identification of programs of measures:
  - Identification of the cost effectiveness of a set of measures;
  - Assessment of the role of pricing as a measure;
- Implementation of programme of measures;
- Evaluation of the impacts of the programme.

Approach

In the year 2009, by order 332, the Ministry of Nature, Environment and Tourism defined 29 River Basins in Mongolia. For the pilot River Basin Management plan of the "Strengthening Integrated IWRM in Mongolia" project, the Orkhon and Tuul River Basins have been selected.

Common research methodologies and approaches like primary and secondary data collection and analysis, and statistical and mathematical approaches were used for the economic analysis. A computational framework in Excel facilitated the analysis of the data, i.e. the analysis of the current socio-economic situation and the economic analysis. The computational model consists of a tailor made socio-economic model and model for the Social Cost Benefit Analysis. The following approaches were used:

a) Analysis of the current socio-economic situation and forecast of development trends: Data has been collected and analyzed to determine current and future policy and assess development programmes on national, regional and Aimag level.

To arrive at the River Basin level based on data available on national and regional level, several socio-economic indicators were attributed to the River Basin based on its share of the Soum territory (like population number, livestock number and agriculture share of the GDP), hydrological characteristics and water use. The macroeconomic, indicators like GDP and industrial share of the GDP, were estimated per Aimag and Soum located in the River Basin.

b) Water demand analysis: The most important part of the socio-economic analysis is the water demand analysis. The demand for water was broken down into separate components according to its use (drinking water, water for irrigation, water for industrial purposes, etc.), and the distribution of the demand (daily, seasonally, etc.).

It is important to note that if the water network has not been well maintained in the past, the demand analysis should include the associated leakages. That is to say that the total water supply is made up of the final consumption (total demand) and the leakages.

The water demand analysis methodology is described in more detail in "the Water Demand handbook".

c) Population growth: To estimate future drinking water demand it is necessary to estimate population growth. For this purpose estimates made by the NSO were used to estimate future population numbers on a national level (1B, 2B and 3A versions of "Population Prospect of Mongolia 2008-2030", which corresponds with high, basic and low scenarios respectively). The population growth in the Orkhon and Tuul River Basins was estimated by drawing a trend line based on population growth in the last 5-10 years of the Aimags and Soum located in the River Basin, and compared with the national prospect. The trend line is based on the simple extrapolation-arithmetic increase method. This method is based on the assumption that the population increases at a constant rate:

$$P_t = P_0 * (1 + r * t) \qquad (1)$$

P_t – population in year t;
P_0 – population in the base year;
r – average growth rate of the population
t – year

d) Livestock growth: The future livestock growth trend is based on data in the "Mongolian livestock programme", which was approved by resolution №23 of the State Great Khural of Mongolia. The livestock growth rate in the River Basins was estimated based on past growth trends of livestock numbers in the Aimags and Soums that are located in the River Basins.

e) Social economic analysis of the RB: The macroeconomic indicators like GDP, industrial product has estimated by aimag, soum center, which are located in the basin and some indicators like population number, livestock number and agriculture product has calculated based on proportion of soum area.

f) Water tariff analysis (water pricing): The water tariff analysis is based on the current water tariff rates, relevant laws and other legal documents in relation to water use, natural resource use fees, financial reports of water supply and sewage organizations, statistical yearbooks, and water pricing methodology of Administration of Land Affairs, Construction, Geodesy and Cartography (ALACGC. [36]

The price of water is a key determinant of both the economic efficiency and the environmental effectiveness of water services. Water tariffs can play an important role in water conservation, effective water allocation and revenue sharing based on social benefits. [44]. For this project, the current water pricing system in Mongolia and its influencing factors was assessed and a water pricing system for achieving various IWRM objectives was developed. [69] A summary of the approach is given in the figure below.

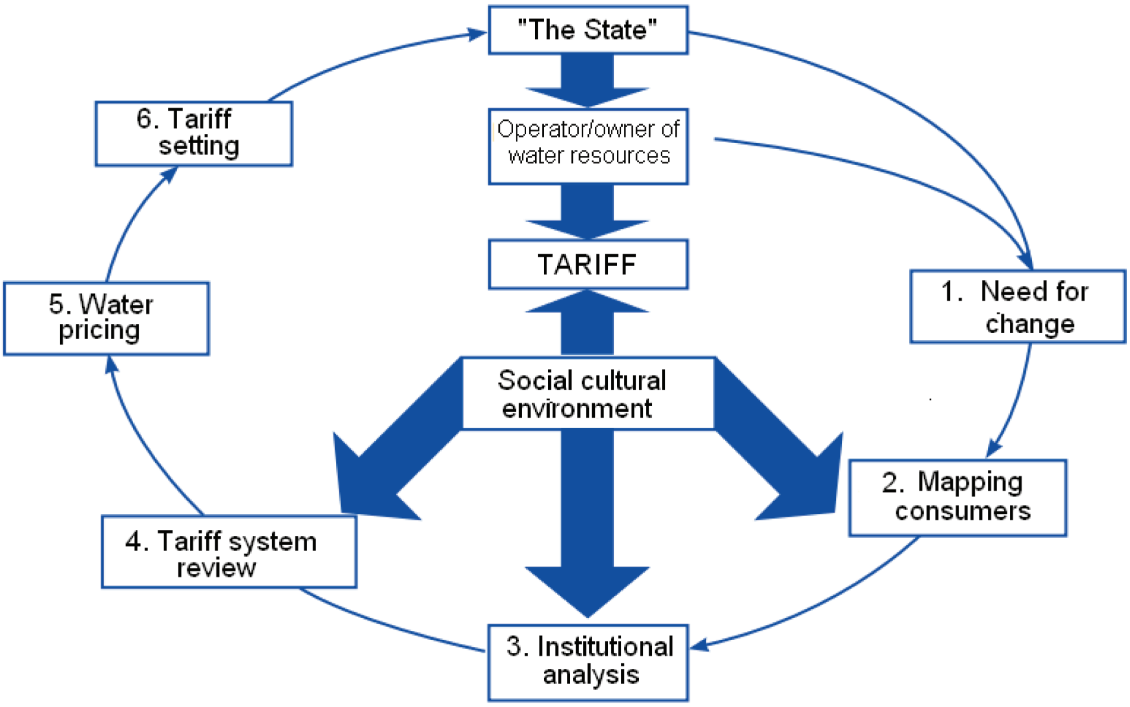


Figure 2. Framework for water tariff decision-making

A step-wise approach is followed for water tariff decision-making. This approach is based on – but not ruled by – sound economics. In this approach two key criteria are important:

- Financial sustainability, requiring the collection of sufficient revenues to meet present and future financial obligations, that is, operating costs as well as the Capital costs of facilities and infrastructure; and
- The user pays principle, which holds that consumers should pay an amount equivalent to the burden of their consumption on society. This implies that charges should attempt to recover full costs, including not only operation, maintenance and Capital replacement, but taking into account foregone benefits (opportunity costs), as well as any externalities (damages to third parties)

The steps that underlie this approach are described below.

Step 1: Establishing the need for change:

The first step is the identification of the need for change. This means that the objectives the new tariff structure aims to achieve or contribute to need to be clear. Examples are:

- Cost recovery
- Sustainability
- Distributive justice
- Tariff system

Enhancing the recovery of costs is a likely objective, but water management decision-makers typically operate in a force field of different and sometimes contradictory objectives. Examples of these contradictory objectives are:

- The "demographic challenge", that is, the obligation to provide more and more people with a basic quantity of good quality water;
- The "efficiency challenge" whereby water management operators need to be converted into efficient and viable organizations;
- The "supply challenge", being the need to supply water to various water users that may have conflicting demands, in order to safeguard the food production or energy production to the population.

Step 2: Mapping of consumers;

The next step is to assess who provides and who consumes water. As water moves through a hydrological cycle, its ownership – whether formally established or not – changes hands at a number of transfer points. This step identifies these transfer points and describes the parties in the chain. This review includes assessing customary rights, attitudes towards paying for water, required service levels and more. [69]

Step 3: Institutional analysis:

The institutional analysis consists of analyzing the social cultural value associated with water, i.e. how do water users perceive water, the legal power of the institutes responsible for water vis-a-vis the power of the users, the skills of the institutes, e.g. Collection efficiency and Operational efficiency, and finally the level of privatization/ decentralization in the water sector. [44]

Step 4: Review of the existing tariff system:

The following step is to take stock of the existing water tariff system: what are its strengths and weaknesses and what trends would affect the system. This step results in an understanding of acceptable practices and helps define the strategy for introducing a new system.

A water tariff is a powerful and versatile management tool. The set up of a tariff system gives decision makers the possibility to focus on social objectives like poverty reduction, or to pay more attention to economic goals, like production or employment. This means that water tariffs have to be satisfying to the average interest of all kind of stakeholders. [69]

Step 5: Calculating the cost of water.

In this step, the economic, social and environmental value of water on the basis of contemporary economic analysis is defined, thereby focusing on long-term marginal Capital cost, operational cost and rent, and subsidies.

In the process of defining the tariffs the following basic issues were important:

- Cost recovery: From the water supplier's point of view, the main purpose of the tariff is cost recovery. Before design can begin, there must be a decision as to how much costs the tariff should recover. Tariff design, then, aims to achieve this target. To a large extent, this consists of setting the various prices and charges in the tariff at a high enough level, which has little to do with the other details of tariff design.
- Economic efficiency: Generations of economists have insisted on the importance of this objective, and noted that it can be achieved by setting all prices equal to their relevant marginal costs.
- Equity and fairness: These terms are often used either together or interchangeably. In fact, they have different meanings. Equity required in public utility tariff design usually means that users pay amounts which are proportionate to the costs they impose on the utility. Fairness, on the other hand, is wholly subjective. Each participant in a tariff design process may have a different notion of the meaning of fairness. One may think it is fair to set a high price for industrial water use, another may not. One may think it is fair to charge all customers the same price (even when, because of cost of service differences, this is not necessarily equitable), while another may believe that fairness requires subsidies to some customers. A marginal cost-based tariff is expected to be equitable, but not necessarily fair.
- Public acceptability: A successful tariff design is one that is not controversial, and/or which does not serve as a focus of public criticism on the water supply agency.
- Political acceptability: A tariff design that is objectionable to political leaders will lead to loss of political support and may cause increased political interference in the operations of the agency.
- Simplicity and transparency: A tariff design should be easy to explain and easy to understand. It should be possible for most users to know what price they are paying for water.
- Net revenue stability: When water use changes as a consequence of weather or economic conditions, revenue and cost should change by approximately equal amounts. When this does not happen, cyclical changes will result in net revenue volatility, creating cash flow and financing difficulties for the agency.
- Ease of implementation: The promulgation and implementation of the revised tariff should not encounter significant barriers in terms of legal authority, administration competence, information requirements, or billing procedures.
- Affordability: Water tariffs should be affordable to its users.

Step 6: Tariff setting

Based on the calculation of costs, the new tariffs have to be approved and implemented according to the law.

The water use payment is equal to multiplication of used amount of water and tariff rate per unit. [69]

a) Water economic valuation

As payment to a large extent depends on the willingness to pay of the water users, a survey has been held in the Ger area of Ulaanbaatar, in some Soum centers of the Tuul River Basin and in Khovd, Bayankhongor, Bayan-Ulgii and Gobi-Altai Aimags. Willingness to pay reflects the maximum amount a person would be willing to pay, sacrifice or exchange in order to receive a good or to avoid something undesired, such as pollution. The results of the survey have shown us that most of the people were willing to pay 1.5 times more than what they currently pay for water. This result is compatible with the WB's study "The Economic Value of the Upper Tuul Ecosystem of Mongolia".

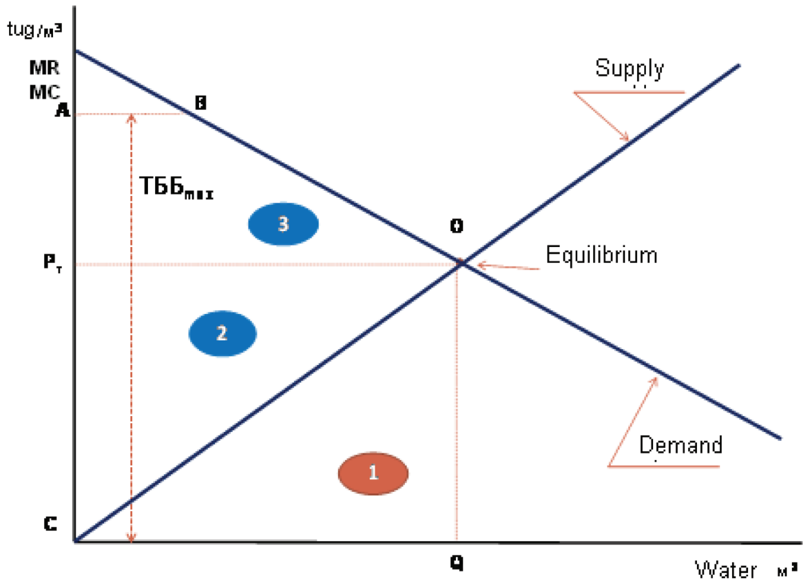


Figure 3. WTP and consumer and producer surplus

Figure 3 shows demand and supply curves, economic surpluses of services and goods. The water economic value is defined by consumer and producer surplus. [].] For this purpose the economists have used the terms: consumer and producer surplus.

In the market equilibrium price is determined by the market price at which the supply of an item equals to the quantity demanded. Otherwise, price and WTP of consumer equals to the marginal cost. Before the equilibrium, marginal WTP[2] is higher than market price.

In the step identifying potential measures the water demand scenarios have to be defined. Based on existing water supply capacity and water demand scenarios measures and costs have been defined. Using less cost analysis and cost effectiveness analysis the effective measures have been defined. Also social cost-benefit analyses where applied.

[2] Marginal WTP is costumers' ability to pay for the additional per unit.

4. Human and Social Development in Mongolia

Since 1990, Mongolia changed its socio-economic system towards a democratic free market economy and has implemented many important changes. Although in the earlier transition period a number of socio-economic indicators of Mongolia deteriorated, in recent years major improvements were achieved in the slipstream of global socio-economic development trends as illustrated by Mongolia becoming a "Medium Human Development' country in 2010 according to HDI.

The Millennium Development Goals (MDGs)-based Comprehensive National Development Strategy of Mongolia, approved by the 12th resolution of the State Great Khural of Mongolia in 2008 defines that "Intensification of global and regional economic development, and creation of more favorable foreign economic and trade environment shall provide additional opportunities for Mongolia to be linked to regional and world markets smoothly, and to offer its goods and services to the rest of the world".

4.1. Administration

"*The territory of Mongolia shall be administratively divided into Aimags and Capital city, Aimag into Soums, Soums into Bags, the Capital city into Districts, and District into Khoroos*" is stated in article 3.1 of the Law of Mongolia on Administrative and Territorial Units and Their Governance. By this law the territory of Mongolia is administratively divided into 21 Aimags in which there are 329 Soums that in turn comprise 1568 Bags and a Capital City having 9 Districts, which are divided in a total of 132 Khoroos. [91] *Table 2* gives an overview of these administrative units. [91]

Table 2. Administrative and territorial units, by region, in 2010

Aimags and the Capital	Number of Soums and Districts	Number of Bags and Khoroos	Territory thousand km^2	Population density (people per km^2)
TOTAL	329/9	1568/132	1564.9	1.7
Aimag total	329	1538	1560.2	1.0
West region	91	466	415.3	0.9
Bayan-Olgii	13	86	45.7	1.9
Govi-Altai	18	83	141.4	0.4
Zavkhan	24	114	82.5	0.9
Uvs	19	92	69.6	1.1
Khovd	17	91	76.1	1.1
Khangai region	99	528	384.3	1.4
Arkhangai	19	99	55.3	1.6
Bayankhongor	20	103	116.0	0.7
Bulgan	16	74	48.7	1.2
Orkhon	2	22	0.8	110.9
Ovorkhangai	19	105	62.9	1.8
Khovsgol	23	125	100.6	1.2
Central region	95	362	473.6	1.0
Govisumber	3	10	5.5	2.6
Darkhan-Uul	4	24	3.3	28.8
Dornogovi	14	60	109.5	0.6
Dundgovi	15	66	74.7	0.6
Omnogovi	15	56	165.4	0.3
Selenge	17	49	41.2	2.4

Aimags and the Capital	Number of Soums and Districts	Number of Bags and Khoroos	Territory thousand km²	Population density (people per km²)
Tov	27	97	74.0	1.2
East region	44	212	286.2	0.7
Dornod	14	63	123.6	0.6
Sukhbaatar	13	66	82.3	0.7
Khentii	17	83	80.3	0.9
Ulaanbaatar	9	132	4.7	246.8

The administrative units are governed by The Citizens' Representatives' Khurals of the Aimag, Capital city, Soum and District; and by public meetings in Bags and Khoroos. Besides the Khurals and public meetings, there are the presidiums and governors of Aimag, Capital city, Soums, District, Bag and Khoroo. [91]

From the development perspective, the territory of Mongolia is divided into 5 economic regions i.e. Khangai, Western, Central, Eastern, and Ulaanbaatar region. Economic development follows the regional programmes. *Figure 4* shows the economic regions with an overlay of the River Basins of Mongolia.

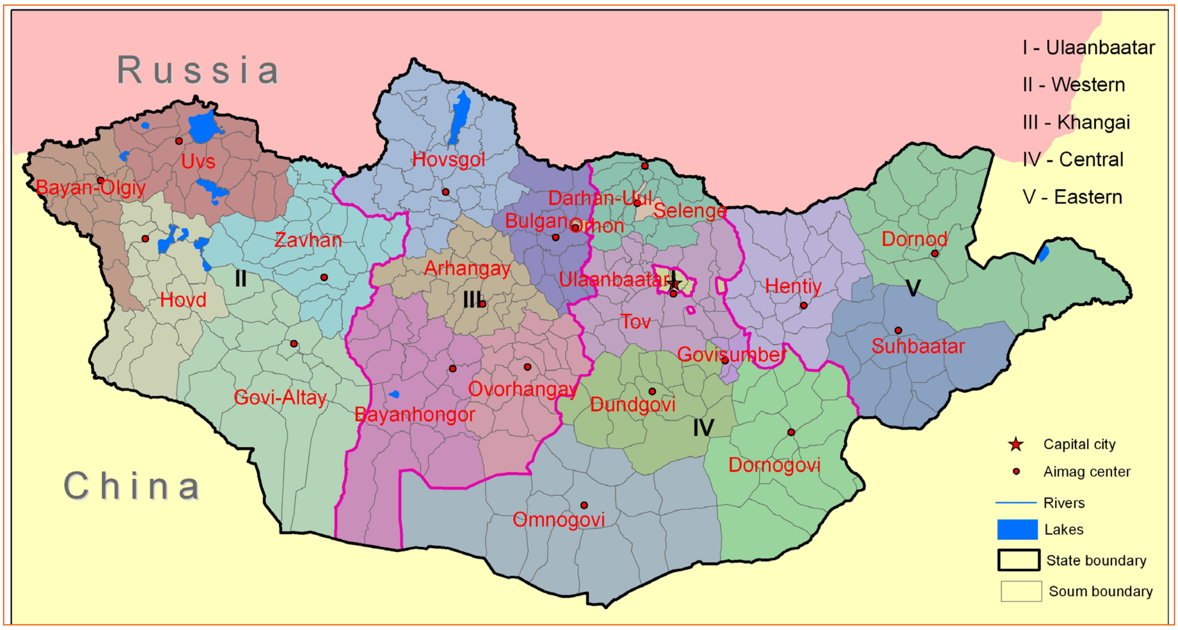


Figure 4. Economic region and aimags of Mongolia, [99]

4.2. Demography

In line with the UNs recommendations, Mongolia organizes a population and housing census every 10 years. The last census in Mongolia was conducted in November 2010. Since 2000-2010, the annual population growth was 1.46% and total population increased by 381.2 thousand citizens to 2,754.7 thousand people. The highest growth rate was observed in Ulaanbaatar, which has an annual growth rate of 5.74%, and the lowest in Zavkhan Aimag, which shows an annual decrease of 2.48%. Next to Ulaanbaatar, the population increased in Orkhon, Umnugobi, Darkhan-Uul and Gobisumber, and decreased in 16 other Aimags. The survey also shows that 107.1 thousand citizens live abroad for more than 6 months. There are over 20 different ethnic groups in Mongolia. According to the 2010 census, 82.4% of the total population was Khalkh, 3.9% Kazakh and 0.1-2.75% belongs to other ethnic groups like Durvud, Bayad, Buriat, Uuld and Tsakhar.

In the project was used National Statistical Office information from 2006-2010. By of the 2010 population of Mongolia was 2,780.8 thousand, from which about 63.3% lives in urban areas. *Table 3* shows the total population from 2006 until 2010, including the division in male/female and urban/rural.

Table 3. Population of Mongolia

Indicator		2006		2007		2008		2009		2010	
		000' persons	Percentage, %	000' persons	Percentage, %	000' persons	Percentage, %	000' persons	Percentage, %	000' persons	Percentage, %
Total		2594.8	100	2635.2	100	2683.5	100	2735.8	100	2780.8	100
of which	Male	1265.3	48.8	1284.4	48.7	1309.9	48.8	1337.7	48.9	1351.7	48.6
	Female	1329.5	51.2	1350.8	51.3	1373.6	51.2	1398.1	51.1	1429.1	51.4
Number of population											
Urban		1579.5	60.9	1601.0	60.8	1659.2	61.8	1713.3	62.6	1760.4	63.3
Rural		1015.3	39.1	1034.2	39.2	1024.3	38.2	1022.5	37.4	1020.4	36.7

Annex 2 shows the population number of Mongolia per Aimag and region, and per city (urban) and countryside (rural), from which the Western and Khangai regions' rural households percentage was high, that is 62.6-67.9%; and that of the Central and Eastern regions' urban households percentage was 39.9-42.4%.

Mongolia is a country with a sparse population; there are 1.75 persons per one square kilometer. There is a discrepancy in the population density numbers for Aimags and Soums though: for example, there are 236.7 persons per square kilometer in Ulaanbaatar and 0.3 persons/square km in Umnugobi. *Figure 5* shows the population density of the various Soums in Mongolia.

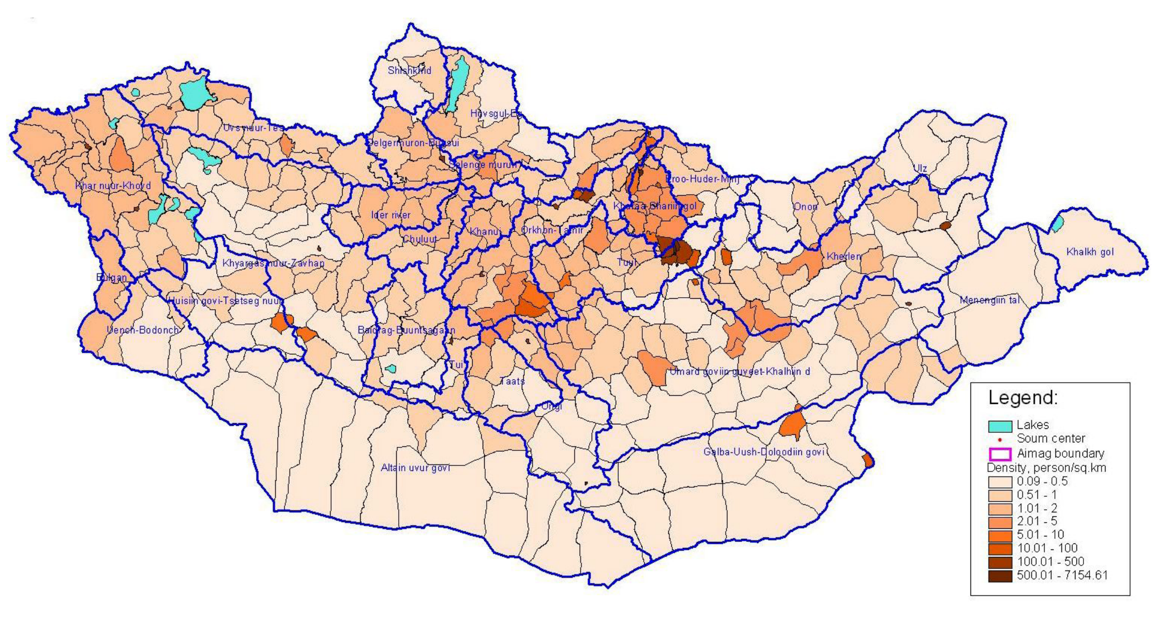


Figure 5. Population density of Mongolia, by Soums

At the end of 2010, the number of people in the Tuul River Basin was higher than in any other River Basin, it represents 43.4% of the total Mongolian population which is 1191.3 thousand people. The population in the Buir Nuur-Khalkh gol River Basin was lowest: 0.1% of the country total or about 3 thousand people. The population density in Tuul River Basin was 23.9 persons per one square kilometer; which is higher than the density in other River Basins due to the presence of Ulaanbaatar in this River Basin. Other River Basins with high population density numbers are Kharaa and Orkhon (4.4-9.4 person/km^2), while River Basins with low density numbers are Buir Nuur-Khalkh gol, Menengiin Tal and Altain Uvur Gobi (0.1-0.2 person/km^2). (See also *Annex 3 for more detailed information*)

According to the inhabitants of the River Basins, there is a relation between the environmental conditions for economic activities, abundance in water resources and the population density. Examples thereof are Orkhon, Tuul, Kharaa andnDelgermurun River Basin. There are regions though that have abundant water resources, but that are far from urbanized areas or where it is complicated to develop infrastructure due to mountain, and taiga area or that are situated in a steppe or desert with sparse water resources like Khuvsgul-Eg, Onon, Uyench-Bodonch, Menengiin Tal and Altain Uvur Gobi. These regions all have a low population density.

Compared to world urbanization and centralization, urbanization in Mongolia developed much stronger since 1990. For example in 2010, the urban population of Mongolia reached 63.3%, while the world urban population was 50.5% [116]. In the last year the urban population of Mongolia increased by 0.7 points. The main cause of urban households' growth is migration.

The main feature of Mongolian migration is the direction of the flow to the Capital. For example, in 2010, 39.7 thousand persons or 51.6% of the total migration flow arrived in Ulaanbaatar, whereas 20.4 thousand people left the Capital. According to the 2008-2010 survey, the predominant migration flow was directed to the regions closer to the market and with developed infrastructure like Ulaanbaatar, Darkhan-Uul, Selenge and Tuv. These regions are all located in the Tuul, Orkhon and Kharaa River Basins. The main migration came from the outermost Aimags like Uvs, Khovd and Zavkhan. (See also *Annex* 4 for more detailed information).

In 2010, there were 742.3 thousand households, which is an increase of 3.6% compared to the previous year. The number shows that there are on average 3.7 persons per household. A percentage of 62.5% of the total households reside in urban areas and 37.5% in rural areas. The *Annex 5* presents the household numbers of Mongolia divided by Aimag and Capital.

The future population growth is important for estimating future drinking water demand. In the management plan three scenarios have been used for estimating the water demand: high, medium (basic) and low that correspond with the scenarios of The Population Prospect of Mongolia 2010-2040 by NSO. Figure 6 shows the estimated population numbers in these three scenarios until the year 2040.

The estimation shows that the population of Mongolia will reahe 3 million by the year 2016 and around 3.1-3.7 million in 2021. The future water demand estimate also distinguishes between rural and urban areas. The full analysis is described in the 'Water demand handbook".

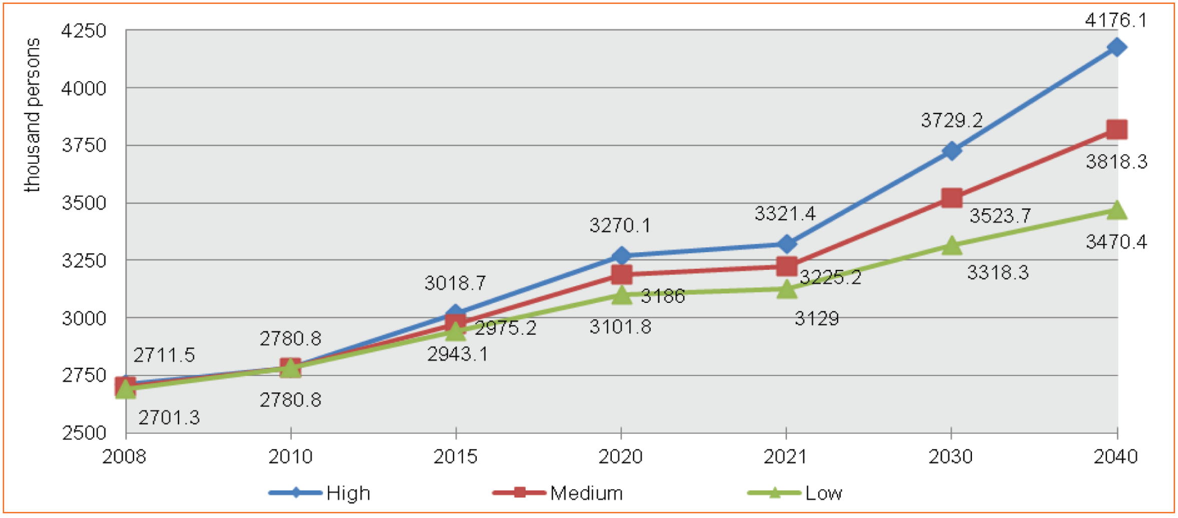


Figure 6. Population prospect of Mongolia, in thousand persons

4.3. Employment

In 2010, there were 1863.4 thousand potentially productive people on national level, of which 1147.1 thousand were actually economically active, which means that 41.3% of the total population participates in economic activities. Almost half, i.e. 47.1%, of the economically active population is female. Unemployment is set at 9.9%. *Table 4* gives an overview of these employment indicators.

Table 4. Employment, in thousand persons

Indicators	2006	2007	2008	2009	2010
Population of working age	1619.6	1642.2	1688.7	1704.4	1863.4
Economically active population	1042.8	1054	1071.5	1137.9	1147.1
Employed	1009.9	1024.1	1041.7	1006.3	1033.7
Registered unemployed	32.9	29.9	29.8	38.1	38.3
Unemployed				131.6	113.4
Labor force participation rate, %	64.4	64.2	63.5	66.8	61.6
Employment rate, %	62.4	62.4	61.7	88.4	90.1
Registered unemployment rate, %	3.2	2.8	2.8	3.3	3.3
Unemployment rate, %				11.6	9.9

Figure 7 shows how the population was divided in 2010 over the various age groups, showing that in total about 67% of the population is at present in the working age group. As about 82% of the people outside the working age group were children under 14 years old, it can be concluded that the labor force resource is high.

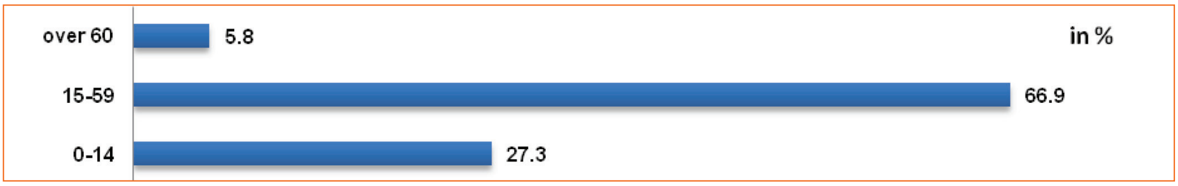


Figure 7. Population by age group, 2010

Recent years' growth rate of the working age population was affected by 1990s high birth rate. In addition to the growing population in the working age group, the annual growth rate of employees has increased to 2.9% in 2008 resulting to a total number of 1041.7 thousand employees. However, the global financial crisis and dsud in 2009 has caused the number of employees to decrease by 3.4%, until in 2010 it increased again to reach 1033.7 thousand.

Since 2009 the statistics related to employment and labor force are estimated according to the "Methodology for Estimation of Employment and Labor Force Indicators" adopted by a Joint Resolution 01/68/94 from the Chairman of NSO and the Minister for Social Welfare and Labor. According to the above methodology, unemployment was 113.4 thousand persons and the unemployment rate was 9.9% in 2010 (See *Figure 8*). Previously, unemployment estimated by registered unemployment. [89-9.]

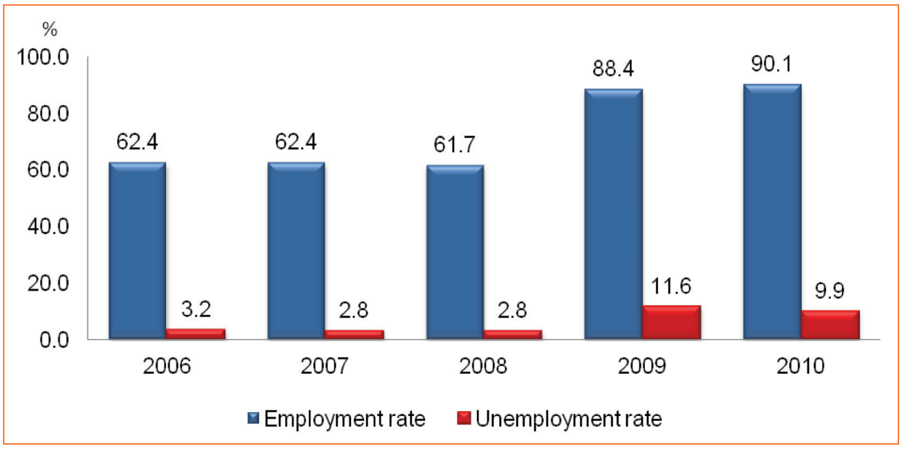


Figure 8. Employment and unemployment rate

Table 5. Employment by sector, in thousand persons

Indicators	2006	2007	2008	2009	2010
Total:	1 009.9	1024.1	1041.6	1006.3	1033.7
Of which: Agriculture, forestry fishing and hunting	391.4	385.6	377.6	348.8	346.6
Mining and quarrying	41.9	44.148	46.5	34.8	34.1
Manufacturing	133.3	139.0	144.4	127.9	133.8
Trade and service	261.5	270.6	282.3	283.9	290
Public and social activities	171.1	173.2	179.1	195.9	216.5
Others	10.6	11.6	11.8	15	12.7

In 2010, 346.6 thousand person or 33.5% of the total employed worked in the agriculture sector and 167.9 thousand person or 16.2% worked in the mining and industrial sector (*Figure 9*, *Table 5*).

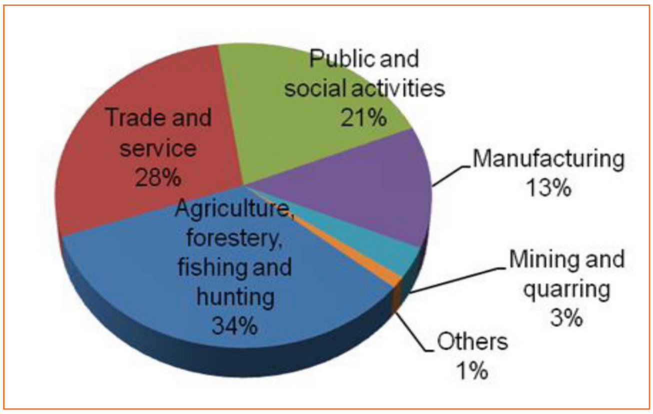


Figure 9. Employment structure by economic sector, 2010

The natural resources, including water resources, are vital for all the social and economic activities. With the economic sectors agriculture and industry (manufacturing and mining) directly depending on water resources, combined with more than half of the employment coming from these sectors demonstrates that the water sector's problems are vital issues. A typical example is the dzud that occurred in 2009 that caused a reduction by 28.8 thousand employees in the agriculture sector, which corresponds with 81.5% of the total decrease in employment that year. This also shows that agriculture plays a major role in employment and is one of the important issues in the social economy of Mongolia. Taking all these into accountsindicates that solving problems related to the water supply will have an immediate effect on the socio-economic and employment situation.

4.4. Education, Culture, Custom and Religion

4.4.1. Education

The education index[3] of Mongolia is relatively high: 0.925 in the 2010. The education system of Mongolia consists of pre-school education, primary and secondary education and higher education.

Pre-school Education

In the 2010/2011 academic year, 122.1 thousand children enrolled in a total of 839 kindergartens, where 4.7 thousand teachers are working. 31.7% of the kindergartens are located in Ulaanbaatar, 17.2% in the Western, 20.5% in Khangai, 19.1% in Central and 8.5% in the Eastern region.

Since 2009, kindergartens are included in every Bag-establishment work, and within this work the UN financed more than 20 kindergartens, amounting to 240.5 million MNT, in Uvs, Khovd, Dornod, Gobi-Altai, Tuv and Ulaanbaatar. This provides opportunities to involve an additional 500 children in pre-school education.

Primary and Secondary Education

In the 2010/2011 academic year, 512.2 thousand children were studying in one of the 751 schools, of which 184.6 thousand or 36% live in Ulaanbaatar. These schools employ 26.4 thousand teachers or 65.3% of the country's total.

[3] One component of HDI, that is measured by the adult literacy rate and the combined primary, secondary, and tertiary gross enrolment ratio. In 2009 the overall countries education indices were 0.280-0.993.

In 2010, 11 schools were built by state budget, and the total number of school seats increased by 5.9 thousand. In addition, 9 dormitories were constructed, thereby increasing the number of beds with 1 thousand. Moreover, through the Government budget, international aid and loans 201 schools, kindergartens, cultural centers, dormitories and sport halls have been rehabilitated and repaired. The ADB's "Education Development programme" invested 1,323.5 million MNT in repairing eight school buildings. [49]

There are also initiatives to enhance school sanitation and hygiene behavior, as this is fundamental for the healthy development of the child. Recent surveys on water, sanitation and hygiene at schools, conducted by the General Agency for Specialized Inspection, indicates that schools connected to water supply and sanitation have 1 toilet per 100 children and 1 sink per 140 children. Most of the time there are not enough hand washing basins in the schools in the Ger areas and Soums. UNESCO and WHO suggest the following optimal standards for the safe water and sanitation[4] in schools:

Water supply:

- Hand washing basins: 1 per 50-100 students
- Showers: 1 per 20 students
- Expected water consumption without shower: 15-30 l/per day per student
- Expected water consumption with shower: 90-140 l/per day per student

Sanitation:

- Girls: 1 toilet cubicle for 25 girls
- Boys: 1 toilet cubicle for 100 boys and 1 urinal for 40-60 boys

This means that in order to improve water supply, sanitation and hygiene conditions at schools, improvements are necessary.

Higher, vocational and technical education

In the 2010/2011 academic year, there are 113 universities and colleges; 16 of those are public, 92 private and 5 foreign. There are 170.1 thousand students studying and 7.2 thousand teachers working at the universities and colleges. In addition, there are 63 vocational and technical schools in Ulaanbaatar and in the 21 Aimags, 46.1 thousand students are studying and 2.1 thousand teachers are working here. Details on the numbers and students of all educational institutions can found in *Annex 6*.

The insufficient water and sanitation situation in the education institutions is an important issue for the water sector. According to the "temporary water use norms of Mongolia", adopted by 153rd order of the Ministry of Nature and Environment from 1995, the water demand in the education sector is set at 75 l per day per child in Ulaanbaatar, Darkhan and Erdenet (Orkhon Aimag) and for other regions at 37.5 l per day per child. For students and teachers, the norm is set at 10-20 l per day. To estimate water demand, the duration of the academic year is set at 180 days and the number of users, both students and teachers, was taken from 2010 statistical data. According to this calculation, the education sector would have used in total 3,411.1 thousand m^3 per year in 2010, of which 1,264.1 was used in pre-schools, 1,414.8 thousand in schools, and 811.9 thousand m^3 in universities, colleges and vocational schools. However, the information collected from Aimags (excluding Ulaanbaatar and Soum centers) indicate that the actual use at pre-schools was 244.6 thousand m^3 per year, and at schools, universities, colleges and vocational schools 778.5 thousand m^3 /per year.

[4] http://toolkit.ineesite.org/toolkit/INEEcms/uploads/1042/Guidelines_Provision_Safe, Guidelines for the Provision of Safe Water and Sanitation Facilities in Schools

4.4.2. Culture, Tradition and Religion

Mongolia is one of the countries in the world where the nomadic culture still remains, and hitherto where people live in close contact with nature. Therefore, the idea of nature worshipping is embodied in the traditions and religions of Mongolia. An example of the preference for nature and homeland is that environmental protection rules are included in the Buddhist creed, legend and folklore. In the 18th century, official protection was given to sacred mountains and water bodies, and it was illegal to pollute the environment, among which rivers and springs, and to hunt in the breeding season of wild animals. Mongolians have always respected these laws.

Mongolian people strive for maintaining the purity of water resources by evading dropping milk and blood, and forbidding pouring dirty water and urinating next to water sources. The Mongolians worship Luvaanjalbuu, the god of pure water, who is located near the Orkhon River, in the Orkhon valley of Selenge Aimag in Orkhon Soum.

Figure 10. Water god Luvaanjalbuu

In 2007, Erdenezuu Monastery in Kharkhorum opened a small temple dedicated to sacred services for the deity of nature. Inside this monastery, there are posters of the fish and animals of Mongolia and a wall chart of ecological rules and guidelines. It is a simple and effective form of local education through faith.[5] Furthermore, shamanism is one of Mongolia's traditional religions in which rituals are performed that are related to the sacrament of the sky, mountain, and water.[6]

Nowadays, many Mongolian herders still continue the nomadic lifestyle and prefer the pastures near water sources. In Mongolia since 1960, a start is made in constructing water supply and sanitation systems for the herders, although many families continue to use wells, rivers and spring water. Within a family, the woman is in charge where water is concerned. Collection of water is usually the responsibility of men. In Ger areas also children collect water. For example, in the Ger area in Ulaanbaatar 45% of those collecting water are men, 29% woman and 26% children. In Altanbulag of Tuv Aimag,

[5] WB, Mongolian Buddhists Protecting Nature, Ulaanbaatar, 2009

[6] WB, Mongolian Buddhists Protecting Nature, Ulaanbaatar, 2009

these numbers are 62.7% men, 20.9 women and 6.3% children. Compared with the 2004 survey, the participation of women and children decreased [46].

As far as distance is concerned in the collection of water, the "Urban poverty and migration survey" from 2002 indicated that 60.4% households collect their water within 300 m, 28% between 0.3 - 1 km and 11.6% from over 1 km. Moreover, in urban areas 73% of the households spend up to one hour to collect water and in rural areas 68.8%. Another 10% of the households in the urban areas and 4.2% in rural areas spend over 2 hours to collect water. The survey carried out for this project, which was conducted in 2009, indicates that 50% of the households collect water within a 200 m distance, 43% between 0.2-1 km and 7% from a distance over 1 km. This survey shows an improvement of the water supply situation in Ger areas.

4.4.3. Health

The Mongolian Human Development Policy aims to have a sustainable population growth and establish decent conditions for a long and healthy life. In line with this statement, the Government has successfully implemented measures that improved the health situation, of which the most notable were the "Strategy for the reduction of maternal death 2005-2011", the "Reproductive Health national programme 2005-2011", the "Action plan to reduce maternal death" and the "National strategy of medicament security and supply".

Proof of its success is that maternal mortality decreased by 26 points compared to the previous year in 2010. However, mortality under children in the age group of 1-5 years increased by 175 compared to 2008. Infant mortality increased by 0.2 points compared to the previous year and reached 20.2 per 1000 birth. According to a survey conducted in 2009 the main reason of mortality under children in the age of 1-5 years are trauma and toxemia (41.3%) in urban areas, and respiratory infection disease in rural areas (38.5%). On the other hand, infection diseases decreased by 2.4 thousand in 2010 compared to 2008 and reached 41.4 thousand, of which water related diseases were 22% hepatitis and 8.3% diarrhea. [108]

In the Capital and Aimag Centers, most hospitals and medical institutions are connected to the central water supply and sanitation systems. Soum centers have begun to install boreholes and small sanitation systems for the hospitals. Examples are the installation of boreholes and sanitation systems in the Department of Health of Baganuur and in hospitals in Delgerkhaan Soum of Khentii, Delger and Taishir Soum of Gobi-Altai. Moreover, the UNESCO project "Comprehensive Community Services to improve Human Security for the Rural Disadvantaged" started to improve water supply and sanitation in hospitals in 5 Soums of Uvs, Khovd, Dornod, Khuvsgul and Bayan-Ulgii Aimags. [105] Since 2008, a joint programme of the Government of Mongolia and ADB, the "Third Health Sector Development Project", is implemented in the health sector. The duration of the Project is from 2008 until 2013 and it is financed through a 14 million USD grant from the ADB and 3.6 million USD from the Government. The objective is to establish 11 new Soum health centers and 2 Family Group Practices (FGP) buildings with improved infrastructure and water sources for 39 Soum health centers. Furthermore, it is planned to implement the "Fourth Health Sector Development Project" by ADB grants and loans.

According to statistical information, 2.4 thousand people worked in health institutions in 2010. In Ulaanbaatar, 124 thousand FGPs provide medical services to 1,112.3 thousand people and in 21 Aimag centers 102 thousand FGPs provide medical services to 609.9 thousand people.

In 2010, only 30 maternal mortality cases were recorded, which is a decrease of almost 50% compared to the previous year. However mortality of children under 5 years was 1700, which is an increase of 175, compared 2008. Infant mortality is more or less stable at 20 per 1000 birth. According to the survey of 2009 the main reason of mortality of children between 1-5 years old were in the urban areas are trauma and toxemia (41.3%) and in the rural areas respiratory infection diseases (38.5%).

For the water demand analysis, the water use norms in the health sector together with the employment number and number of patients were used. For Ulaanbaatar, Darkhan and Erdenet (Orkhon Aimag) and Sukhbaatar the water use norm is 250 l per day per patient and for other Aimags and Soums it is 125 l per day per patient. For patients that do not stay for the night and for the employees the water use norm is 20 l per day per person. The number of patients and hospital bed comes from the “Morbidity and mortality report of Mongolia-2010”. In 2010, the water use in the health sector was 1337.3 thousand m^3 per year. The information obtained from Aimags gives a water demand of 1059.0 thousand m^3 per year, but this excludes Ulaanbaatar.

4.4.4. Human Development

Human Development Index

The Human Development index (HDI) is one of the socio-economic indicators that measure country’s development by combining indicators of life expectancy, educational attainment and income. Since 1997, Mongolia started to publish a Human Development Report supported by UNDP. The MDGs based Comprehensive National Development Strategy of Mongolia aims to reach a HDI of 0.83 in 2015. The past and current HDIs are presented in the graph below.

Figure 11. HDI of Mongolia, 1990-2010

In 2010, Mongolia's HDI was 0.622, which ranks the country at 100 out of 169 countries placing it in the Medium Human Development countries [12.] This HDI is slightly below the World average of 0.624 and that of East Asia and the Pacific, which is 0.650. By UNDP’s estimation, Mongolia’s life expectancy index was 0.748, the education index 0.674 and the GDP per capita index 0.477. According to the WB classification of Gross national income per capita by the Atlas methodology, Mongolia’s GNI per capita reached 1630 USD categorizing it as a “Lower middle income country”.

In recent years, the National Statistical Office estimated the HDI on Aimag and regional level (*Annex 7*). In 2010, the highest HDI was measured in Orkhon Aimag (0.845) and the lowest in Dornod Aimag (0.682), which is mainly caused by the higher per capita income in Orkhon Aimag.

Household Income and Expenditure

In 2010, monthly average household income was 448.0 thousand MNT: in the urban areas this was 498.1 thousand MNT and in the rural areas 386.6 thousand MNT (see *Table 6* for more information). At national level 86.4% of the household income is monetary income, 9.3% from household business and 4.3% from other sources. And 51.7% of monetary income comes from salary and wages, 17.4% from pensions and allowances. In rural and urban areas this composition is totally different though, with 72% of household income coming from salary, wages, pensions and allowances in urban areas and 40% in rural areas. In rural areas, 48.1% of income stems from privatesbusiness (*Figure 12*).

Since 2000, the NSO conducts quarterly sample surveys on wage: the "Survey on average wages and salaries of employees". Based on this survey the average wages and salaries are calculated by economic sector, type of enterprise, ownership form and by age, gender and occupation type. According to this survey results the average salary of employees was 341.5 thousand MNT in 2010, which is an increase of 13.6% compared to the previous year and a 24.5% increase compared to 2008 [93]. Furthermore, the average monthly real wage of employees increased by 3.2% compared to 2009. In the mining and quarrying sector the average real wages and salaries grew with 28.1% even. However in the social services sector it decreased by 11.7%.

Table 6. Monthly average income and expenditure per household, in MNT

Indicators		2006	2007	2008	2009	2010
Income	Country average	200 179	263 681	363 594	402 525	448 027
	Urban	181 165	269 472	406 667	454 854	498 172
	Rural	207 588	254 090	305 216	331 600	386 605
Expenditure	Country average	228 172	292 488	367 466	437 602	450 602
	Urban	232 188	308 016	421 924	471 336	501 042
	Rural	211 644	266 768	293 653	391 883	387 937

Source: NSO

In 2010, the monthly average expenditure per household reached 450.6 thousand MNT on national level, which is translated in an urban expenditure of 501.0 thousand MNT and rural expenditure of 391.9 thousand MNT. The share of monetary expenditure in the average expenditure per household was 86.5% in kind (*Figure 12*).

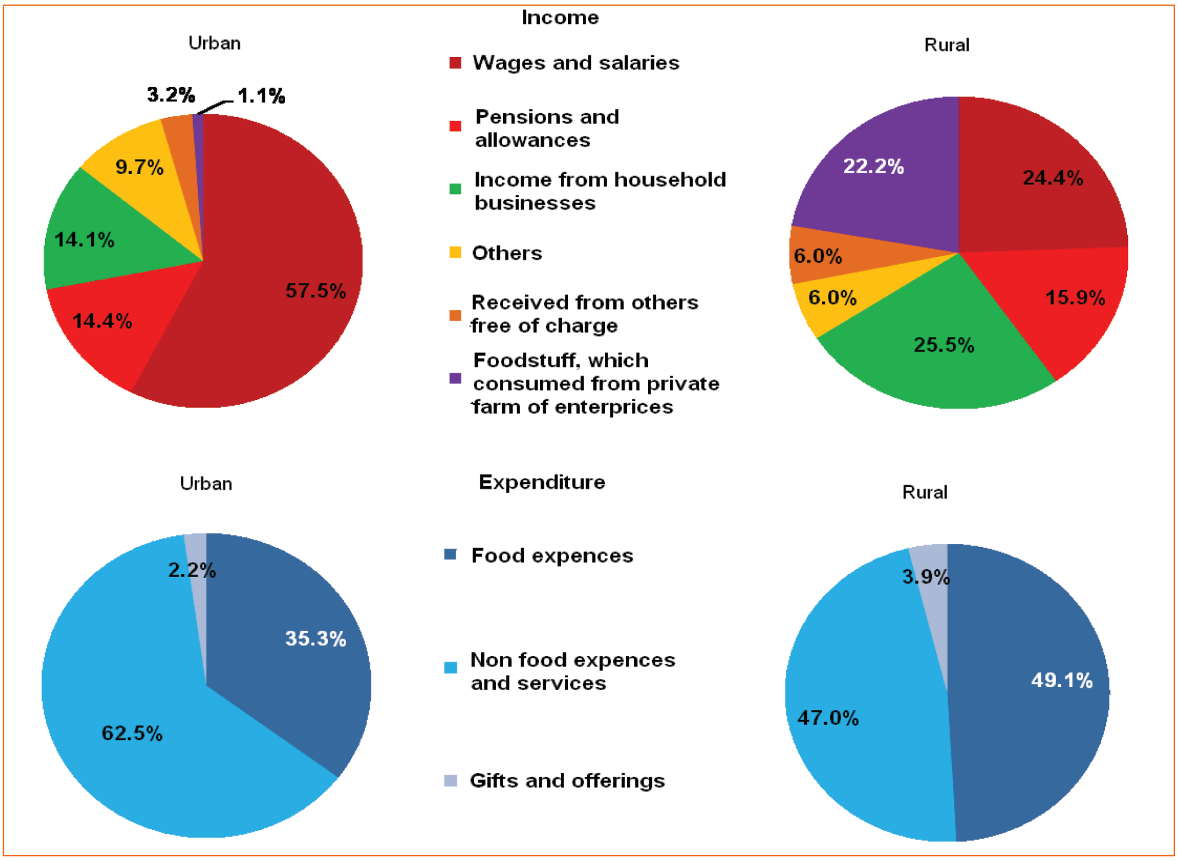


Figure 12. Composition of Household income and expenditure, 2010

The estimated water and wastewater expenses from average monthly expenditure of a family of four persons in the Ger area is MNT 1.8 thousand, whereas households in apartments connected to the central water supply system without water meter pay MNT 18.7 thousand (water 12.8 and wastewater 5.9). This equals 0.3-4% of the monthly average household income.[7] However, for low-income family it is 0.7% in the ger area and 7.3% in apartments. This shows that when considering the water tariff situation more attention should be given to the low-income families in apartments.

Since 1998, according to the Law on Statistics and the Law on Defining Minimum Subsistence Level of Population (from 1998) the NSO has defined the minimum subsistence level of the population by region. *Table 7* shows the minimum subsistence levels in 2006-2010.

Table 7. Minimum Subsistence Level of Population, in MNT/per month per person

Region	2006	2007	2008.II	2008.X	2009	2010
Western	37 000	54 700	70 700	94 300	96 100	97 000
Eastern	34 800	51 800	65 600	85 100	86 300	90 900
Central	39 000	56 700	73 100	90 800	91 200	91 700
Khangai	38 300	54 600	70 600	89 000	90 600	91 500
Ulaanbaatar	42 800	60 100	73 300	94 800	101 100	101 600

Source: NSO

[7] By recommendation from EBRD water and waste water expense have to be under 5% of household income.

The Millennium Development Goals (MDGs)-based Comprehensive National Development Strategy of Mongolia" aims to reduce the poverty headcount index by 2 times and to "create a regulatory mechanism to ensure full participation of all forms of enterprises and citizens in poverty reduction, and rapidly reduce poverty". *Table 8* presents the poverty headcount index. A poverty headcount index indicates the proportion of the population that lives below the poverty line.

Table 8. Poverty headcount index in percentage, by region

Indicator		2002-2003	2007-2008	2009	2010
Country average		36.1	35.2	38.7	39.2
Urban		30.3	26.9	30.6	32.2
Rural		43.4	46.6	49.6	47.8
Region	Western	51.1	47.1	48.7	51.1
	Khangai	38.7	46.6	55.2	51.9
	Central	34.4	30.7	29.3	29.3
	Eastern	34.5	46.7	43.8	40.6
	Ulaanbaatar	27.3	21.9	26.7	29.8
Location	Capital	27.3	21.9	26.7	29.8
	Aimag center	33.9	34.9	37.0	36.2
	Soum center	44.5	42.0	42.6	38.8
	Rural	42.7	49.7	53.2	54.2

Source: NSO

While in the MDGs aims, the poverty headcount index has increased to 39.2% in 2010, which is composed of an increase of 7.9 percentage points in the Capital, 4.5 in rural areas, 1.3 in Aimag centers and a decrease of 3.2 percentage points in Soum centers. The main reason for the rapid growth of poverty in the Capital is the migration of herders who had lost their property in the 2009-10 dzud.

Water Poverty Index (WPI)

In 2002, for the purpose to express an interdisciplinary measure that links household welfare with water availability and water scarcity, C. Sullivan and a research group of the Economic Department of Keele University defined a Water Poverty Index. Applying this to 140 countries rates Mongolia at the 4^{th} level with a low WPI (See *Figure 13*).

The WPI is defined by the following five indicators:

1. *Resources* indicate water availability and quality. This index combines internal water resources and external water inflows.
2. *Access* is defined from three components: percentage of the population with access to safe water, percentage of the population with access to sanitation and an index, which relates to irrigated land as a proportion of arable land to internal water resources. This index takes account of water and sanitation needs and agricultural water supply.
3. *Capacity* is defined by GDP per capita, under-5 mortality rate, education index and Gini coefficient (measure of inequality based on the Lorenz curve). This index shows the relationship between socio-economic variables and access to water and quality.
4. *Use* has 3 components: domestic water use per capita, industrial use and agricultural water use (m^3/cap/year).
5. *Environment* is defined by environmental indicators, which reflect water provision management.

Source: http://maps.grida.no/go/graphic/water-poverty-index-by-country-in-2002

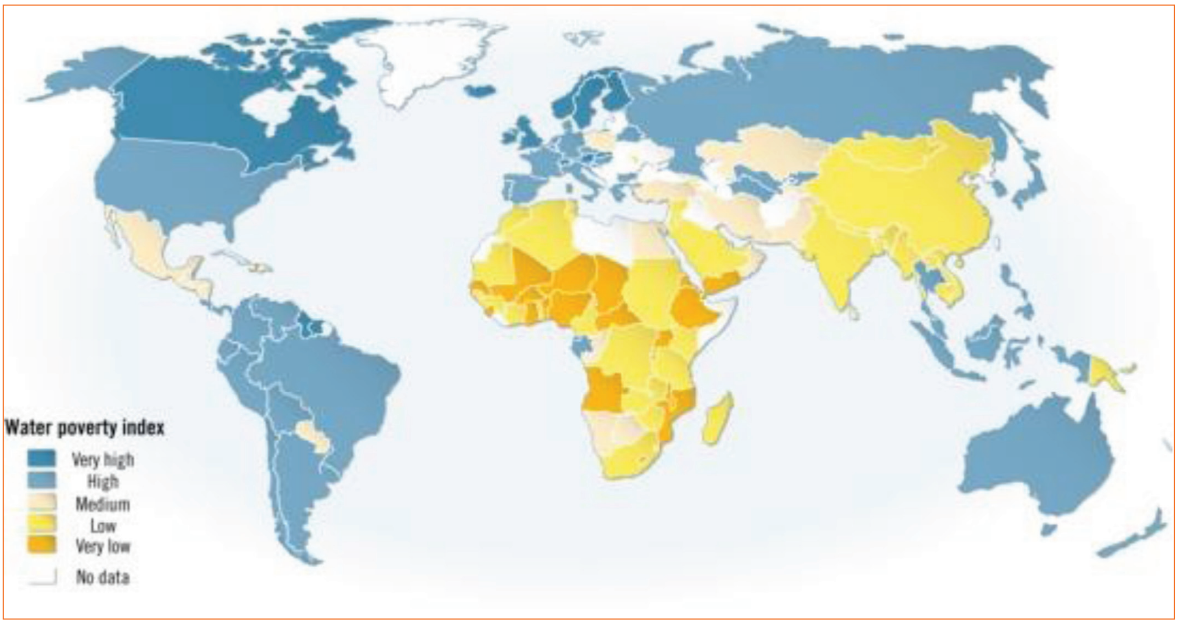


Figure 13. World WPI map

Mongolia was ranked 60th from 147 countries [127]. From the components that determine the WPI, Mongolia scored lowest on access to water and sanitation. This component will be improved if the water supply and sanitation situation in Ger and in rural areas is improved. *Table 9* presents the WPI of various countries.

Table 9. Some countries WPI

No	Country	Resource	Access	Capacity	Use	Environment	WPI	HDI*
1	Haiti	6.1	6.2	10.5	6.5	5.8	35.1	0.467
2	Nigeria	6.4	4.4	4.4	9.9	10	35.2	0.274
42	China	7.1	9.1	13.2	12.1	9.7	51.1	0.718
46	Vietnam	10	6.4	14.4	13.3	8.3	52.3	0.682
48	India	6.8	11	12.1	13.8	9.5	53.2	0.571
58	Nepal	10.2	8.7	11.2	12.6	11.8	54.4	0.48
60	Mongolia	11.1	8.8	12	11.2	11.8	55	0.569
68	Singapore	1.2	20	16.8	7.8	10.3	56.2	0.876
79	Kazakhstan	10	13.3	15.6	10.1	9.4	58.3	0.742
93	Belarus	6	20	18.5	8.8	7.3	60.6	0.935
95	Argentina	12.4	11.9	15.3	8.5	12.8	60.9	0.842
105	Korea	6.1	19.3	17.7	8.4	10.9	62.4	0.875
108	Russia	13	12.6	16.1	9.1	12.5	63.4	0.775
114	Japan	8.1	20	18.9	6.2	11.6	64.8	0.928
116	USA	10.3	20	16.7	2.8	15.3	65	0.934
131	Netherlands	7.9	20	18.2	8	14.4	68.5	0.931
135	Turkmen	10	17.7	14.7	16.7	10.9	70	0.73
146	Canada	15.5	20	18.7	6.9	16.5	77.7	0.936
147	Finland	12.2	20	18	10.6	17.1	78	0.925

Source: C.Sullivan, 2002

Future Trend of Social Development

The MDGs based "Comprehensive National Development Strategy of Mongolia" defines six priority areas for development. The first concerns the achievement of the Millennium Development Goals and provision of an all-round development for the Mongolian people. Within this priority area, "a policy shall be pursued to fully achieve the Millennium Development Goals and reach human development index of 0.83 by 2015". In 2008, the State Great Khural of Mongolia adopted the 13th resolution and updated the MDGs, which was approved by the 25th resolution of State Great Khural. Goals that are targeted:

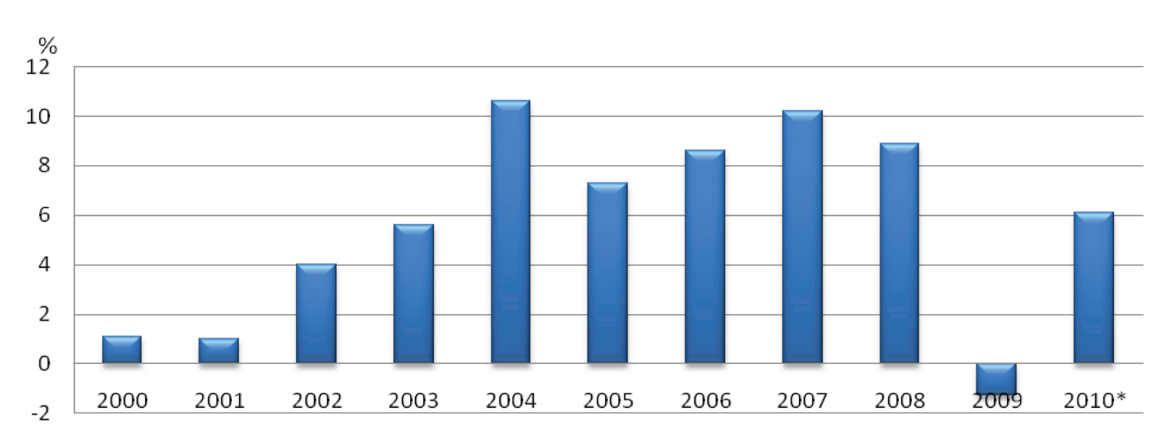
- Reduce poverty headcount to 18% and poverty gap ratio to 6% by 2015;
- Increase per capita GDP to 6800 thousand MNT at current price;
- Reduce unemployment for the people aged between 15-24 to 2.5%.
- Reduce proportion of population using unimproved water sources to 40% and proportion of population with inadequate sanitation facilities to 60% by 2015;
- Increase the number of apartment households that are connected to the central water supply and sanitation system to 30% of the total population by 2015.

5. Economic Development

5.1. Macro Economic Situation

Since 1990, the Mongolian economy has transferred from a centralized to a market economy, and in the early transition period was faced an extremely difficult situation. During 1990-1992 the GDP declined by more than 20% and prices increased 6.5 times.

The GoM adopted measures to improve the social-economic development, consequently from 2002 economic growth climbed again and the annual growth of GDP reached 4% and more. However, in 2009 the real GDP decreased again with about 1.3%, industrial sectors value added production with 3.2% and the budget deficit reached 342.6 billion MNT due to the global financial crisis and the drop in gold and copper prices.[8] In 2010, the Mongolian economy is resurging and the real GDP grew by 6.1% and the growth of the industrial sector was 10% (*Figure 14*). Inflation on the other hand jumped to 13%.



*Comment: * preliminary estimates*

Figure 14. GDP growth of Mongolia in percentage

In 2008, Mongolia's GDP was 6,019.8 billion MNT at current prices and 3,564.3 billion MNT at constant prices of 2005, in 2010[9] that increased to 4,354 billion MNT at constant prices of 2005 and 8,255.1 at current prices (*Figure 15*). The GDP grew due to a growing service sector (23.4%), quarrying 11.3%, and mining 6.3%. The agriculture sector still feels the impact of the 2008-2009 dzud with a 16.%% contraction in 2010.

In 2010, of total GDP 15.9% was produced in agriculture, 35.6% in the industry and 48.5% in the service sector. From 2008, the share of the agriculture sector to the GDP decreased due to dzud. From 2006 until 2009, the share of the industrial sector decreased to 32.1% due to changes of the production in the mining sector. For example, from 2006 to 2009 the share of the mining sector to the GDP decreased from 30% to 19.8% because of a declining output of gold mining products and a drop in world market prices. In 2010, due to increasing world coal demand (mainly in China) the coal export of Mongolia increased 2.4 times.

[8] Mongolian Statistical Yearbook
[9] Preliminary estimates

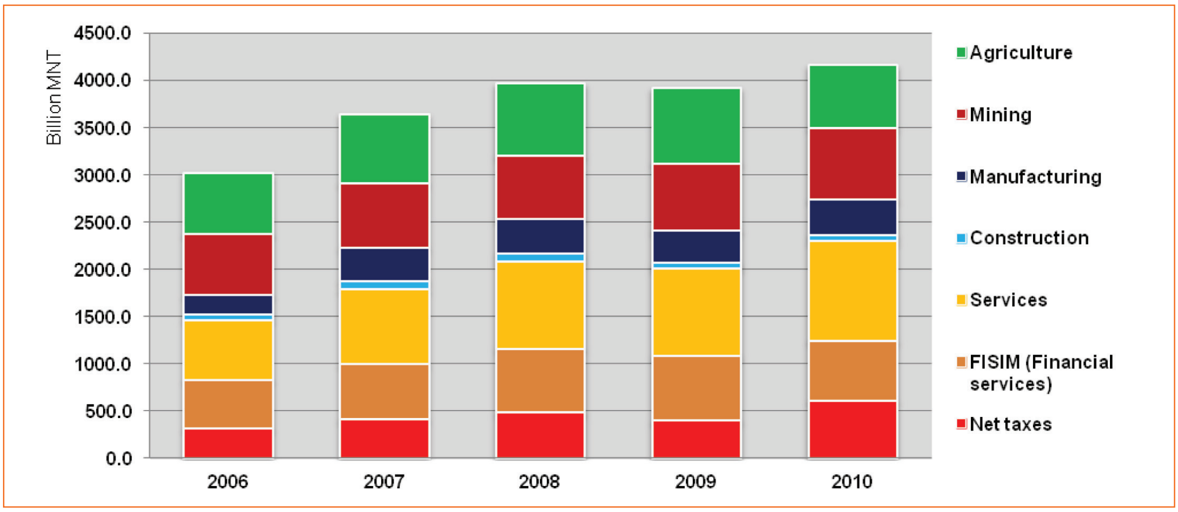


Figure 15. GDP by economic sectors, at 2005 constant prices

According to Figure 15 in 2010 value added production of service sector increased by 123 billion MNT or 13.2% from 2009. Irycontemporary, the agricultural sectors value added production reduced by 133.8 billion MNT.

In 2010, 62.7% of GDPwhas produced in Ulaanbaatar, 18.1% in the Khangai, 11.1% in the Central, 4.7% in the Western and 3.45 in the Eastern region. From 21 aimags, Orkhon Aimag generated 862.7 billion MNT, which was 10.5% of total the GDP (See Annex 8).

The GDP per capita estimated by the WB in 2008 was USD 1663, in 2009 that was USD 1669 and in 2010 jumped to USD 2470 [111].

The national consumer price index in 2010 has increased by 13.0% over the previous year, mainly related to increases in food prices. The annual average inflation rate for 2010 was 10.1%. A disturbing trend is the continuing upward trend of the consumer prices. Rising local food prices due to the recent dzud and global food prices.[10] In order to strengthening domestic demand the GoM raised public sector wages with 30%[11] and provided substantial cash handouts to the population. Such initiatives increase demand thereby causing an upward inflationary trend.

5.2. Infrastructure

5.2.1. Transportation

Road and Transport

The Mongolian road and transport sector is playing an important role in the Mongolian economy, which has a vast territory that is sparsely population. The Road and Transport system was established in 1920, by Order of GoM. Currently, about 12.6 million tons of freight and 246.7 million passengers were carried by road transport per year. In 2010, the freight turnover reached 1,834 million tonkm and the total revenue is 172.2 billion MNT.

The GoM focuses on the development of roads and is implementing the “Millennium Road” program, “National Transport Strategy for Mongolia to 2021”, the Mongolian Road Master Plan 2008-2020, etc.

[10] Worldbank, quarterly economic update, 2011
[11] ADB, Monoglia Development Outlook, 2011

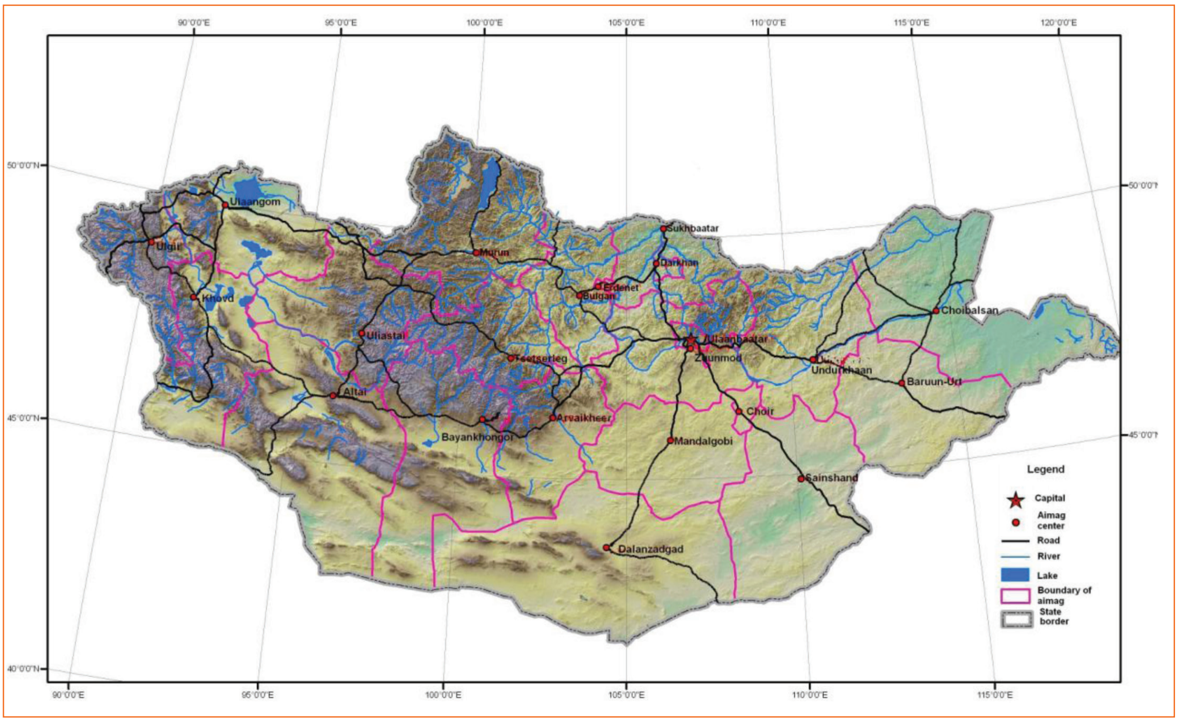


Figure 16. State level road map of Mongolia

Mongolia has over 12.6 thousand km of road of a state or international status and 38.0 thousand km of local roads. In 2010, Mongolia had a total 6,734.4 km improved roads, of which 3,015.6 km are paved roads and 2,071.6 km are gravel roads. There are a total of 663 concrete and wooden bridges in our country. There are 181 concrete and 102 wooden bridges along the roads with national status.

Paving of the "Millennium Road" started from Ulaanbaatar city in 2001. The investment in the road sector increased 9.8 times between 2000 and 2009. Some 1960 km paved road and 480 km gravel road were constructed. In 2010, 283.7 km of paved road was constructed, including Dashinchilen-Orkhon Bridge, Ugiinuur-Khushoo tsaidam, Kharkhorin-Tsetserleg and other local roads. Investments amounting to 18,279.5 billion MNT are projected in the sector's building and maintenance work until 2016.

Railway

The Mongolian railway was established in 1938 and the first railroad was built between Ulaanbaatar and Nalaikh. Currently, Mongolia has about 1,800 km of railway, of which about 1,100 km long trunk line, which runs between Russia and China through Ulaanbaatar.

The State Great Khural of Mongolia pursuant to Resolution № 32 dated June 24, 2010, endorsed: the State Policy on Railway Transportation (the "Railway Policy") for the purpose to expand the national railway network, to modernize and improve railway capacity, to support the development of big mines and processing and export of its products. In 2010 construction works for the first stage of the rail infrastructure started consisting of approximately 1,100 kilometers traversing the route Dalanzadgad – Tavan Tolgoi – Tsagaan Suvarga – Zuunbayan and Sainshand – Baruun-Urt – Khuut – Choibalsan.

Figure 17. Current and planned railroads in Mongolia

In 2010, the Mongolian railway transported some 3.5 million passengers and 16.7 million tons of freight. The total revenue was 307 billion MNT.

Source: www.miat.com

Figure 18. Mongolian aviation map

Others

The Mongolian aviation system was established 85 years ago. At present, the Mongolian airlines fly to Tokyo, Seoul, Berlin, Moscow, Erkhuu, Beijing and domestic destinations. The following airline companies are operating in the country: MIAT, Aero Mongolia, Eznis Airways, Trans-Ulgii, Khanigard and Tengeriin Ulaach. As of 2010, airlines transported 397.1 thousand passengers and 1.6 thousand tons of cargo. The total revenue estimated at 125.6 billion MNT. Water transport in Mongolia is limited to Khuvsgul Lake and its revenue estimated at 32.0 million MNT in 2010.

The transport sector organizations used about 1.8 million m^3 water in 2010. In the future, the water demand of the sector will increase to 2-3 times of its present use due to the booming economy.

Communication

In the Mongolian communication sector about 400 companies and entities are active. In 2010 the revenue of the sector reached 401.6 million MNT. Most of the communication organizations are connected to the centralized WSS system and its water is included within the municipality's water use.

5.2.2. Electricity

The Mongolian energy system consists of 4 regions: Western region energy system, Altai-Uliastai energy system, Central region energy system, and Eastern region energy system. There are 7 thermal power plants, the Dorgon and Taishir hydro-power plants and the Altai and Uliastai diesel generators as well as small renewable energy plants that produce electricity. The distribution system comprises 6 220 kW substations with 1400 km power line, 69 110 kW substations with 4240 km power line, and 3689 0.4-35.0 kW substations with a total of 28.2 thousand km energy-transmitting line.

Source: Renewable Energy Report, APCTT-UNESCAP

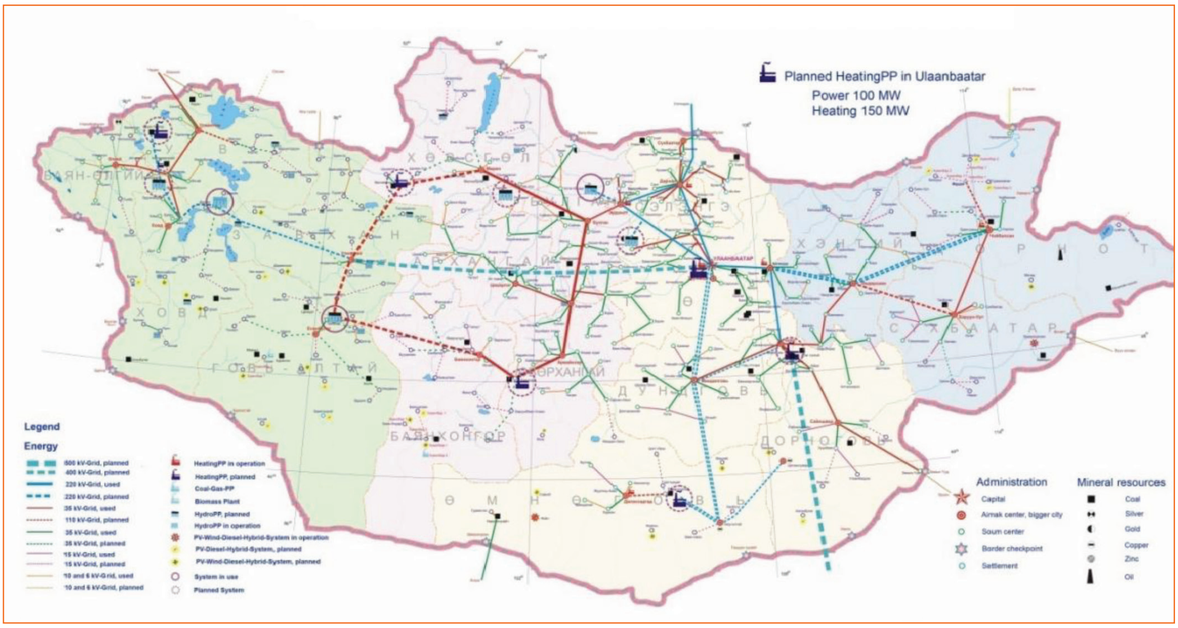


Figure 19. Map of Mongolian power system

In Mongolia 318 soum centres and settlements are connected to a power grid, and 8 are powered by renewable and diesel energy sources.[12]

The Central region energy system consists of TPPs no 2, 3, and 4, Darkhan and Erdenet TPPs, the central region distribution system and Ulaanbaatar, Darkhan, Erdenet and Baganuur distribution stations. The central region system provides electricity to

[12] http://www.mining.mn

Ulaanbaatar, Khangai and Central region (except Umnugobi) and Khentii aimag centers and 270 soum centers.

The Western region energy system imports electricity from Russia and provides the Uvs, Bayan-Ulgii and Khovd aimags. The system consists of four substation and 462.5 km power line. Electricity usage is about 60 million KWh in per year and the maximum power load in the winter 14 MW power and minimum load of 900 KWh in the summer. In 2009, the Durgun HPP was established.

The Altai-Uliastai energy system provides the Zavkhan and Gobi-Altai aimag and consists of diesel generators. In 2010, work started on the Taishir HPP, at costs of 38.9 million USD.

The Eastern energy system is served by the Choibalsan TPP and provides electricity to the Dornod and Sukhbaatar aimags. Currently, completely satisfied energy needs of Eastern region users but in the future related to the mines of Mardai and Tumurtei energy demand will increase and a current capacity will be insufficient.

At present Umnugobi, Zavkhan and Gobi-Altai aimags are not connected to an energy system. Since 2000, the Dalanzadgad TPP is operational in Dalanzadgad of Umnugobi aimag and produces 16 million KWh electricity per year and sells 11.7 million KWh electricity and 19.2 thousand Gcal thermo energy. With the establishment of Oyu Tolgoi and Tavan Tolgoi mines energy needs will grow rapidly in future.

5.2.3. Water Supply and Sewerage System of Urban Area

Urban services developed in parallel with the establishment of the city and settlement areas in Mongolia culminating in the development of centralized water supply and sewerage facilities. Urban services play a significant role in providing a pleasant living and working environment for people, providing optimal conditions for industries and services to develop and operate, and protecting the environment and people's health.

Most of the water supply and sewerage networks were established during 1960-1990, and are now quite outdated, hampering reliable operation and require rehabilitation.

Water Supply

Statistical data from 2010 report the presence of 1288 kiosks, of which 945 kiosks are run by PUSOs. Out of these 38.8% or 367 kiosks are connected to the centralized system and 61.2% or 578 kiosks utilize water trucks and need to be connect to the centralized system [100].

In the Ulaanbaatar the WSS system is operated and managed by USUG.[13]. The system includes 4 water sources, 6 water transfer pumping stations, 175 deep wells (boreholes), 232 kiosks connected to the centralized system, and 298 unconnected kiosks, 350.3 km water supply pipes, 147.7 sewage pipes and 172 km water supply lines in the ger area

21 aimag centers and some other cities have centralized WSS systems. Of these, the water source for Altai city, the aimag center of the Gobi-Altai aimag, cannot satisfy the water needs and meet drinking water quality standards.

One of the World development indicators is improved water sources (percentage of population with access to improved sources) and improved sanitation facilities (percentage of population with access to improved sanitation).

13 http://usug.ub.gov.mn/index.php?option=com_content&view=article&id=69&Itemid=129, 2010.12.10

Table 10. Improved water supply source coverage of Mongolia in percentage

Water sources	2005	2010
Centralized WSS system	22.0	36.6
Connected kiosks	8.5	13.6
Protected deep wells	8.6	19.3
Protected springs	0.1	-
Total	39.2	69.5

Source: Estimation by MRTCUD based on MDGs of Mongolia

The MDGs of Mongolia aimed to increase the percentage of population with adequate water supply to 60% and increase the percentage of the population receiving improved sanitation services to 40% by 2015. *Table 10* shows improved water supply sources coverage of Mongolia. In 2005, access to the improved water sources was 39.2% and that was 20% below the global average.

Sanitation Service and Sewerage System

Over 60% of population of Mongolia lives in urban areas of which only 22% uses a centralized sanitation system. Most of the ger areas, in which most of urban dwellers live, soum centers, summer places, soum center hospitals and schools, tourist camps, resorts and spa centers are not connected to a centralized system and use water from water trucks and pit latrines. That may affect the soil and ground water to become one of the causes of pollution. Moreover sewerage water cannot be treated upto standard. Therefore, the growing urbanization concentrating the population, the industrial development is likely to cause a negative effect on the environment and on human health. It is estimated that about 400 thousand m^3 wastewater was treated in Mongolia but a breakdown per sector is not available yet.

A survey on the operation and the equipment of the Waste Water Treatment plants revealed that there are 103 waste water treatment plants out of which 41 (39.8 percent) operate normal treating waste water to the standard level, 27 (26.2 percent) do not operate up to standards and 35 (34.0 percent) do not operate at all (see *Figure 20)*.

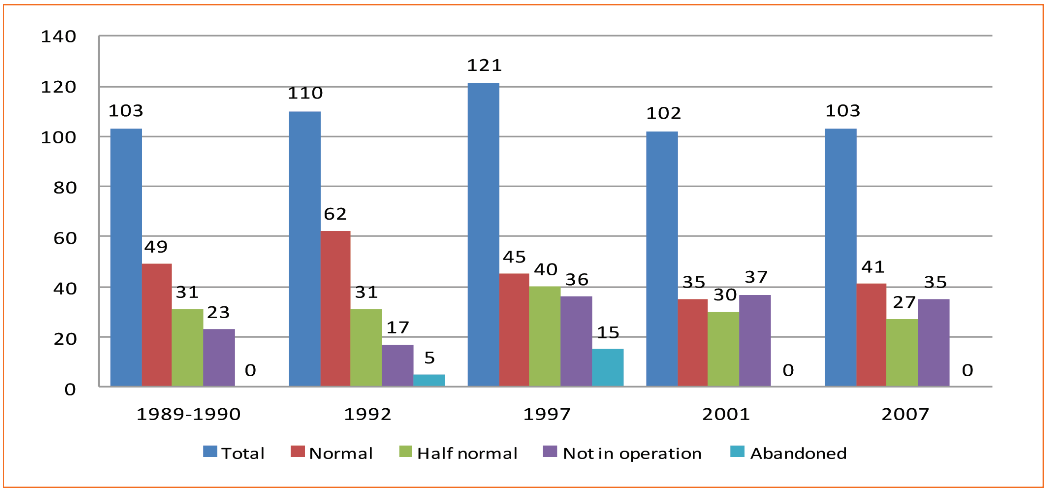


Figure 20. Wastewater treatment plant operation in city and settlement areas

Some of the wastewater treatment plants in the big cities, in aimag centers and in soue centers are operating under PUSOs. There are about 33 facilities and 19 of them are having a normal operation but 14 of them are not having a normal operation. Measures are being taken to renovate and improve the wastewater treatment plants in the urban areas.

Lack of financial resources has caused delays in repair, maintenance, rehabilitation and renovation on the wastewater treatment plants. Treatment in the aimag centers and industries in the settlement area decreased,greducing the volume of wastewater treated. Since wastewater treatment is declining, the standards are not enforced anymore, the level of treatment is falling and untreated wastewater is disposed of directly in the natural environment. The operation of wastewater treatment plants in the rural areas and remote locations has come to a standstill due to a lack of professional organizations and personnel to operate them.

The operational standards require the establishment of the level of treatment through laboratory test, but such laboratories are only available in the wastewater treatment plants of Ulaanbaatar, Baganuur, Darkhan Uul, Orkhon, Zuunkharaa and Khotol.

The test results of the wastewater treatment plants' level of treatment show that suspended solids as ammonia, chromium, nitrogen, oil product and oil are constantly exceeding the permissible limits. The test results of wastewater from a tannery show that the amount of oxygen and suspended solids are exceeding the limit by a factor 5-20 and to also containesulphate and sulfide. This in turn causes technological problems for the Ulaanbaatar City Central wastewater treatment plant.

5.3. Agriculture

Agriculture plays an important role in the Mongolian economy. This sector provides for the population's needs for food and agro-industry

In 2010, the production of the agriculture sector amounted to 1,312.4 billion MNT, which is 15.9% of the total GDP and 12.5% of national exports. Of the national labour force 33.5% was engaged in the agriculture sector. Till 2000, agriculture, including livestock herding, made up 30-40% of the GDP of Mongolia, but after that the share of agriculture decreased year by year. This is partly explained by a rapidly growing share of the service sector and some natural disasters that occurred. Animal husbandry accounts for 75-90% of the agriculture sector's production [94-96].

5.3.1. Animal Husbandry

Animal husbandry is a core issue in the history and development of the nation and still plays an important role in the economy, employment and export revenues of Mongolia. In 1990s livestock breeding made up 87.6% of the agricultural production and in 2010, it still made up 75%, while it employed 327.2 thousand people, demonstrating the importance of the livestock sector for the Mongolian economy.

In 2010, there were 327.2 thousand herders and 160.2 thousand herder families. Besides that another 216.6 thousand families possess livestock, of which 26% have other sources of income as well. *Table 11* provides details on the number of herders and herder households.

Table 11. Number of households and herders, age composition, [NSO]

Indicators	2006	2007	2008	2009	2010
Households with livestock, (thousand)	225.3	226.1	227.5	226.6	216.6
Herders household, (thousand)	170.8	171.6	171.1	170.1	160.3
Herders, (thousand)	364.4	366.2	360.3	349.3	327.2
Age group, %					

Indicators	2006	2007	2008	2009	2010
Between age of 16-34	49.5	48.5	46.9	45.1	43.5
Between age of 35-55 female, 35-60 male	37.9	38.7	40.0	41.1	43.9
Pensioners	12.6	12.8	13.1	13.8	12.6

From 2008 to 2010 the number of herders decreased by 33.1 thousand persons which is a decrease of 9.2% and the number of herder households reduced with 10.8 thousand or 6.4%, which can be attributed to the dzud. However, families doing livestock breeding like subsidiary farm, increased to 56.3 thousand. The number of herders and herder households decreased mainly in the Western region while it increased in Darkhan-Uul, Orkhon, Gobisumber and Khentii aimags (*Annex 9, Table 11*). The number of herders under 35 years old is reducing steadily every year.

The 2010 the livestock census revealed that 82.8% of the herder families have electric generators, 90.1% of which rely on renewable energy and 19.2% have their own wells.

Worldwide livestock comprises 40.3% cattle; while in Mongolia, 42.4% of the total livestock were goats and 44.2% sheep.

By the end of 2010 a total of 32,729.5 thousand heads of livestock were counted, which is 11,294.4 heads less or 25.7% compared with the previous year, due to the harsh winter and dzud. The 2010 livestock census recorded 1920.3 thousand horses, 2176.0 thousand cattle, 269.6 thousand camels, 14.5 million Sheep and 13.9 million goats (*Figure 21*).

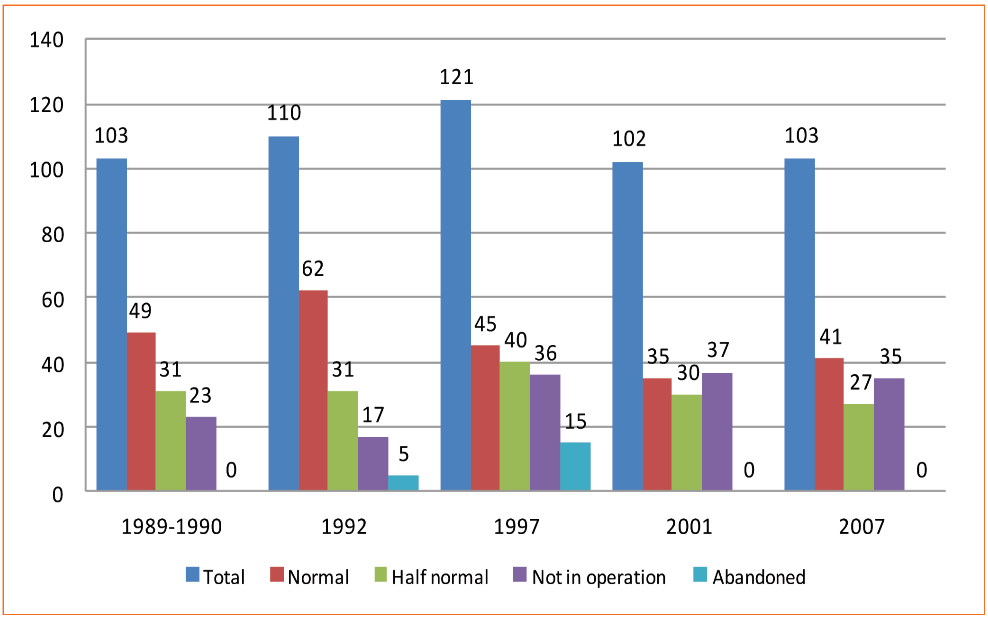


Figure 21. Composition of livestock, 2010

A survey carried out by Mongolian researchers revealed that goats are causing 3 times more damage to pastureland than sheep.sTraditional livestock husbandry practices have taught the appropriate proportion of goats among the small animals is 25-30%. But as a result of increasing world demand for cashmere, the proportion of the goats in the total livestock is increasing.

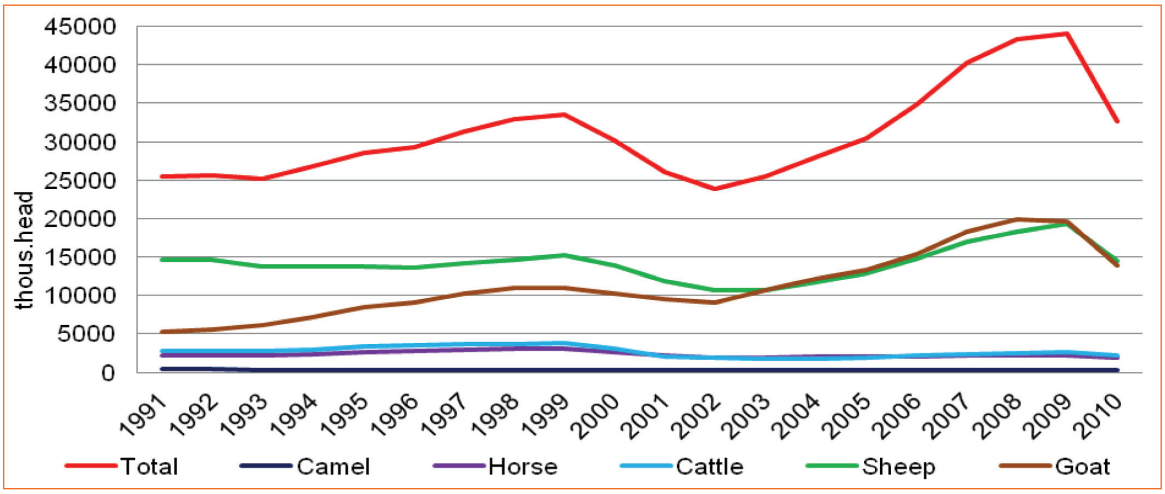


Figure 22. Livestock number of Mongolia 1991-2010

Figure 22 demonstratsd how the livestock numbers changed from 199lluntil 2010. The changes in the number of small animals ars (muchghlarger than for the large animals. As shog io Figure 0, the total number of livestock increased by 28.2% in 2010 compared to 1991. The number of camels reduced by 49.8%, horses by 15.1%, cattle by 23.6%, and sheep by 4%, while the number of goats increased 2.7 times. The increasing number of goats can be attributed to demand for cashmere.

A pasture livestock breeding intensification program which included actions such as veterinary services, selective breeding, fodder production, construction of fences that lead to increasing livestock numbers through reducing animal loss, abortion and non-impregnation, proved to be the most effective way to increase economic returns. However, little has been done to increase the biological effectiveness, i.e. to increase the output of meat, wool, cashmere, milk etc.

Table 12. Livestock number and composition

Type of livestock	2006		2007		2008		2009		2010	
	Number,,000' head	%	Number, 000' head	%	Number, 000' head	%	Number,000' head	%	Number,,000' head	%
Camel	253.5	0.7	260.6	0.6	266.4	0.6	277.2	0.6	269.6	0.8
Horse	2114.8	6.1	2239.5	5.6	2186.9	5.1	2221.3	5.1	1920.3	5.9
Cattle	2167.9	6.2	2425.8	6.0	2503.4	5.8	2599.3	5.9	2176.0	6.6
Sheep	14815.1	42.6	16990.1	42.2	18362.3	42.4	19274.7	43.8	14480.4	44.2
Goat	15451.7	44.4	18347.8	45.6	19969.4	46.1	19651.5	44.6	13883.2	42.5
Total	34802.9	100	40263.8	100	43288.4	100	44023.9	100	32729.5	100

In *Table 12* the composition of Mongolia's livestock is presented. During the last 2 years the proportion of goats in the total livestock was decreasing as a result of the dzud and of the reduction in cashmere prices. The number of livestock in 2010 per region, aimag and RB please is presented in *Annex 10 and Annex 11.*

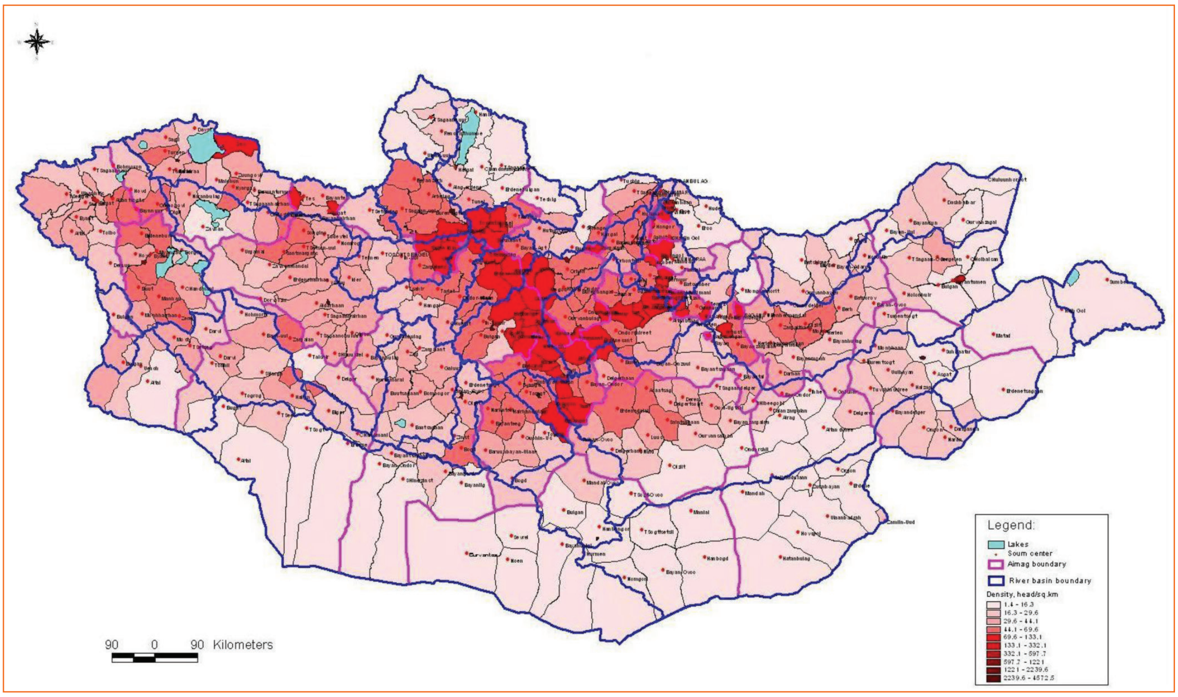


Figure 23. Livestock density by soum and RB

Annex 11 provides the livestock distribution by RB. The highest number of livestock is found in the Umard Goviin guveet-Khalkhiin dundad tal basin with 3608.3 thousand heads, or 11% of the total, while the lowest is in the Buir Nuur and Khalkh gol with 55.3 thousand head or 0.2% of the total. In the Orkhon and Tuul RB 8.7-8.8% of the total livestock are kept (see *Figure* 23).

Intensive livestock farming

The policy of the GoM focuses on the development of intensive livestock farming for the purpose of satisfying domestic and foreign market requirements to produce high quality, safe products, to improve the competitiveness of the livestock sector and to raise the living standards of herders.

At the end of 2010 the number of highbred livestock had reached 1604.1 thousand heads and the indigenous bred livestock 2139.8 thousand heads that was a decrease of 26.4% and 29.2% respectively from the previous year.

Table 13. Highbred livestock farms

Type of farms	2006	2007	2008	2009	2010	2010/2009 %
Milk, cattle	395	494	412	523	649	124.1
Meat, cattle	7	10	48	94	101	107.4
Meat and wool, sheep	13	15	57	107	128	119.6
Pig breeding	72	79	172	135	190	140.7
Chicken	81	111	225	105	148	139.6
Bee-keeping	31	40	56	58	68	117.2
Total	599	750	980	1035	1284	122.8

To support intensive livestock farming the GoM provides support in the form of loans resulting in an increase in the number of highbred livestock farms to 1284 (*Table 13*). From these 16.4% were located in Ulaanbaatar and 20.8% in Tov aimag. In 2010, as reported by the Ministry of Food, Agriculture and Light Industry there were 21.4 thousand milk cows, 11.3 thousand meat cattle, 101.7 000' meat and wool sheep, 15.1 thousand pigs and 397.5 thousand chicken and 3.2 000' bee colonies.

Factors affecting animal husbandry in Mongolia

The precipitation during the vegetation growth period combined with the rate of evaporation puts the moisture availability in 86.1% of the total area under stress concentrated in dry region.[14] According to scientists, 70% of the total pastureland has deteriorated due to effects of global warming, uneven distribution of rainfall, inappropriate human activities and overgrazing.[15]

Animal husbandry foremost relies on pasture and water. Some researchers estimated that the annual fodder reserve of Mongolia in terms of fodder units is about 33 million tons. According to the assessment on pastureland use of the Research Institute of Animal Husbandry and other related organizations from 2000, the pasture capacity of Mongolia is 70-86 million of animals in terms of sheephead equivalent if there is an ordinary climate and environmental condition and water supply is adequate. However, grazing capacity can decrease to 50 million of animals in terms of sheephead equivalent depending on climate and environmental conditions like dzuds, droughts or severe precipitation.

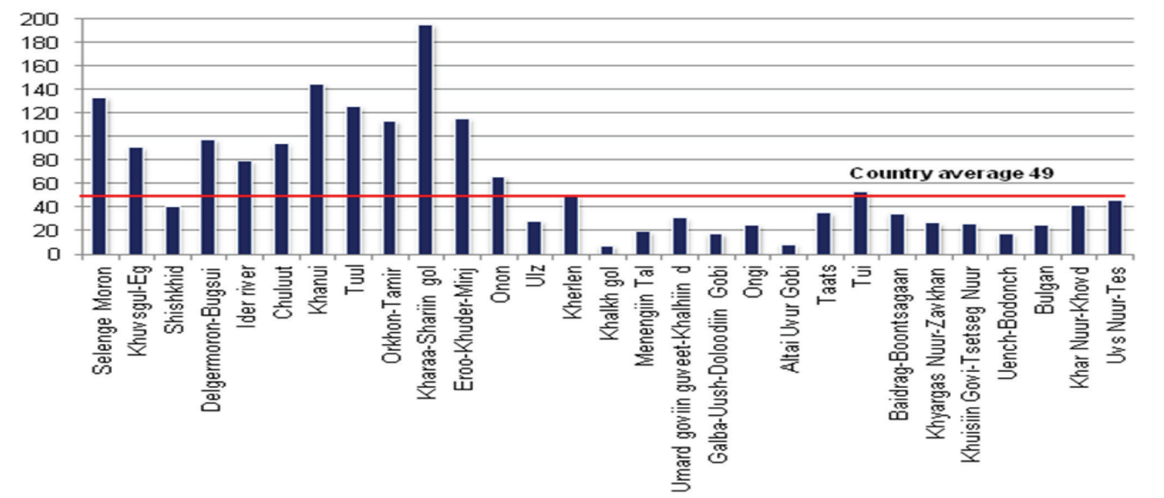


Figure 24. Livestock number in terms of sheephead equivalent per 100 ha pastureland in river basins, 2010

Preliminary results of the land report 2010 of ALACGC indicateaMongolia has 113.0 million ha ofdpastureland. Converted into heads of sheep equivalent the density of livestock reached 49 per 100.ha, which implies a decrease by 12 from the previous year. From *Annex 12* and *Annex 13* it shows that the highest overgrazing occurs in Orkhon aimag with 771 heads of sheep equivalents per 100 ha. When looking at River basins, (*Figure 24, Annex 12*) it shows that in basins with abundant surface water like the Orkhon, Selenge, Tuul and Khanui, the number of livestock per 100 ha area is in excess of 100 heads of sheep equivalents while in the steppe, and desert regions like Buir Nuur-Khalkh gol, Menengiin tal, and Altain Uvur Gobi the density is only 7-19 heads of sheep equivalents.

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[14] Inception phase report "Agricultural water supply management: tradition, present condition and problems"

[15] http://www.greengold.mn/index.php?lang=1&id=243&cont=3, Introduction of project of law on Pastureland, 2010.

NAMHEM each year define grazing usage of the winter and spring pasture, based on livestock number, yield and grazing period.

Source: NAMHEM

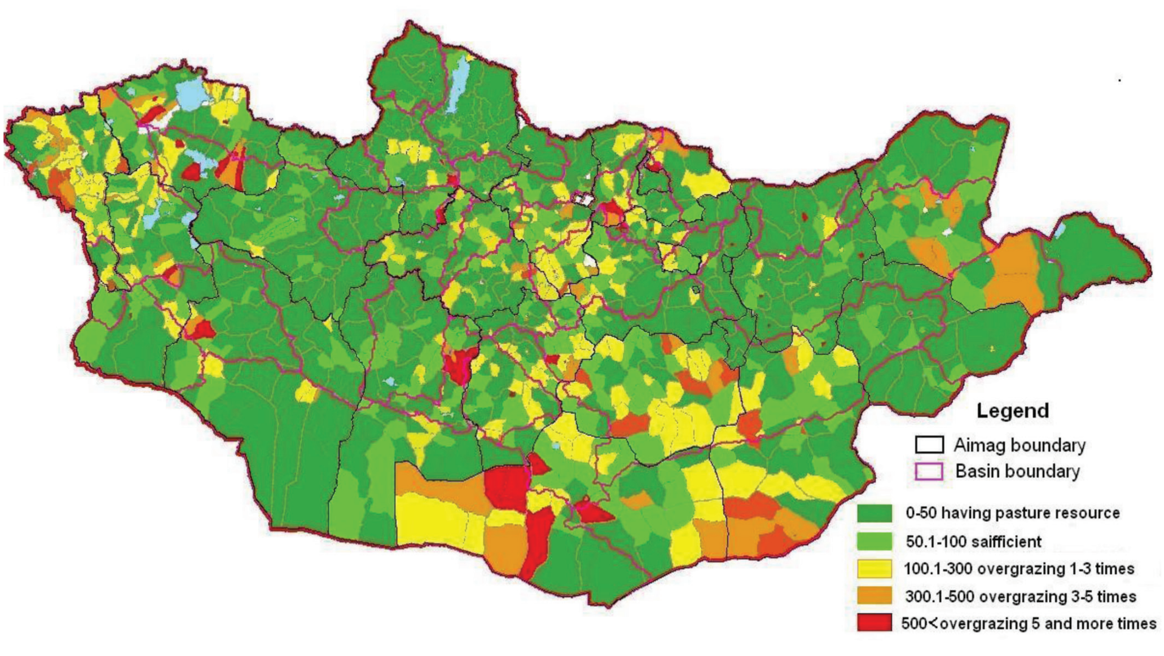

Figure 25. Pasture use in autumn and winter season 2011 by soums

According to the 2011 results of the survey on grazing capacity / pasture use by NAMHEM soums in Bayan-Ulgii, Dundgobi (most soums), Umnugobi, Dornogobi, Uvs and Uvurkhangai aimags pasture were overgrazed.

Currently, the Central region is overgrazed especially in the northern parts of the Kharaa, Orkhon, Tuul, Selenge, Khanui and Erou RBg.

In 2010, 618.6 thousand tos of fodder was produced in Mongolia, which marked an increase of 23.9% from the previous year. This i. 11.3 kg fodder unit perpsheephead, which was 4.1 kg higher than in 2009. In following table fodder production of Mongolia is shown.

Table 14. Fodder crop, in thousand ton

Type	2006	2007	2008	2009	2010
Gross hay harvest	983.3	933.1	1030.9	912.3	1137.3
Straw	4.0	8.5	11.1	8.5	8.3
Handmade fodder	34.0	35.4	34.4	25.8	32.7
Produced mineral fodder	0.7	1.3	0.9	0.5	4.0
Mineral fodder	48.5	50.5	583.8	44.4	48.0
Total, in terms of fodder unit	535.9	513.4	560.4	499.2	618.6

To conserve pastureland MFALI spent 1228.0 million MNT from the state budget in 2010 for pest control in 10 aimags covering 500.8 thousand ha of pasture and 500.0 million MNT to exterminate grasshoppers in two aimags covering 147.0 thousand ha of pasture.

Pasture water supply.

Pasture water supply has been a one of the main issues of Mongolian livestock husbandry. For the nomadic herders the search for water has always been the struggle for existence. For centuries herders used to move from one pasture to another following the water sources, like rivers, lakes and ponds to feed their animals with nutritious grass. Surface and groundwater sources have provided water for nomadic livestock husbandry. [67]. Water supply for the herders was not considered as a separate issue and as a result some herders use proper drinking water, while others use inappropriate water with high levels of mineralization, and some fetch drinking water from far away to satisfy their drinking water needs.

Currently, for livestock watering about 3.8 thousand rivers and creeks, 1.2 thousand lakes, 6.9 thousand springs, 500 tanks for livestock and 39.3 thousand wells are used [92]. Near to water sources the high livestock concentrations increase the deterioration of the pasture and causes water pollution.

Figure 26. Livestock watering in manmade rain and snow collecting pond

Since 1960, the Government has focused on water issues, which resulted in the establishment of water departments in each aimag provided with professional staff, machinery and equipment. By 1990 there were over 29 thousands engineered and mechanical pumping wells and over 17 thousands herder-made wells were improved. Water reservoirs with a capacity of 8-16 m^3 were constructed (1024 reservoirs during 1976-1980) in dry areas with unfavorable geological and hydro geological conditions to preserve.

In addition since 1976, in areas with limited surface and groundwater sources, pasture irrigation has been introduced. As a result, 65.4 percent of the total pasture area (winter and spring) was provided with water. However, during the 90s, in the transition period to the market economy, many wells were destroyed and pilfered or became useless due to a lack of maintenance.

In 2004, the pasture water supply activities were revived. Every 3 years MFALI conducts a census of wells and irrigation schemes. The 2009 census indicates 42.3 thousand wells, of which 10.2 thousand or 24.1% are engineer construction wells and another 32.1 thousand or 75.9% simple wells and reservoirs with a total volume of 92.5 thousand m^3. Of the wells 26.8 thousand or 63.4% are located in the pasture and 7% are not used.

Table 15 shows the number of new and reconstructed wells during 2006-2010 and *Annex* 14 details the new and reconstructed wells by aimag and region. In 2010, over a thousand wells were constructed and 1.6 thousand wells were reconstructed at a cost of 7415.3 million MNT. from the state budget. For further details on investment please refer to chapter 6.

Geophysical exploration of ground water and inventory of water sources started in Bayan-Ulgii, Bulgan, Dornogobi, Dornod, Uvurkhangai, Umnugobi and Khentii.

Table 15. New and reconstructed wells of pasture, [93-95]

Type	2006	2007	2008	2009	2010
New wells	1516	1987	1323	1249	1004
Of which: Drilled wells	345	916	724	505	483
Dug wells	1171	1071	599	744	521
Reconstructed wells	2143	1945	1386	1428	1631
Of which: Drilled wells	934	633	324	217	284
Dug wells	1209	1312	1062	1211	1347

The livestock husbandry is one of the major water using sectors in Mongolian with a consumption of 94.9 million m^3 in 2008 and, 77.2 million m^3 in 2010, which amounts to 13.8 and 16.7% of country's total water use respectively

Livestock development trend

In 2010, the "Mongolian Livestock" National program was adopted through the 23rd resolution of State Great Khural. The objective of the program is to develop a livestock sector that is adaptable to changing climatic and social conditions and create an environment where the sector is economically viable and competitive in the market economy, to provide a safe and healthy food supply to the population, to deliver quality raw materials to processing industries, and to increase exports.[16]

Furthermore, the program is to ensure a sustainable development of the livestock sector and to create a legal environment that will promote economic turnover, to improve traditional livestock breeding and to develop cooperation between nomadic herding and the intensive livestock keeping. It also aims: to increase the productivity and production of high quality livestock products and to improve efficiency; to develop the livestock sector based on region; to restore destroyed pastureland; to improve fodder production; to develop a procurement system of livestock raw materials and to introduce economic instruments related to the quality of raw materials.

Chapter 3.4.3 of the Livestock program aims to implement exploration work to find appropriate sites and develop new water wells based on herders' ideas and initiatives. It is planned also to develop cost-sharing methods into livestock water supply for building and repairing new wells. It is necessary to increase ownership responsibility, transfer responsibility for use, protection and maintenance of new and repaired wells. The program projects the number of newly constructed wells in 2012 to reach 2400, in 2015 to reach 3600, and in 2021 to reach 2686 wells, while on the other hand the National Water program presents a construction target of 800-1000 wells per year.

According to MFALI estimates, the number of livestock will reach 36,475.6 thousand by 2021, of which 45.1% are sheep, 32.0% goats, 13.8% cattle, 8.2% horses and 0.9% camels (*Table 16*).

Table 16. Estimation of livestock number by thousand head

Type of livestock	2008*	2012	2015	2021
Camel	259.7	266.7	282.4	328.3
Horse	2207.7	2134.0	2400.3	2991.0
Cattle	2510.7	2567.4	3388.7	5033.6

16 National Livestock Programme

Type of livestock	2008*	2012	2015	2021
Sheep	18354.1	14971.2	16025.7	16450.5
Goat	19955.8	13404.0	13201.8	11672.2
Total	43288.0	33343.4	35298.9	36475.6

5.3.2. Crop Farming

Since thegbeginning of the transition period large state property farms were privatized. In the one hand, the advantage of this process was to change the monopoly structure of agriculture farming with huge expenditure,ion the other hand escaped an agricultural policy on machinery and technology and significantly fallen down efficiency of crop sector.

Since the middle of the 90s, to support the crop sector the GoM pays special attention to crop farming. For example, programs have been implemented to support agrarians in 1997 such as the “Green revolution” National programme, in 1999 the “Revival of crop” programme, in 2001, the “Seed” sub program in 2002 and the “Fallow” programme etc.

During 2008-2010, the “3rd Crop Rehabilitation” national program was successfully implemented that invested a huge amount of money, which in 2010 resulted in a harvest of 366.3 thousand tons of cereals, from which 344.5 thousand tons of wheat, 5.0 thousand tons of barley, 3.1 thousand tons of oats, 538 tons of bread-corn, 205 tons of buckwheat and others. In addition, there were harvested 169.0 thousand tons of potato, 90.3 thousand tons of vegetables and 12.9 thousand tons of other crops. With this Mongolia could completely satisfy the annual domestic requirements for wheat and potatoes and for vegetables by about 54%. In future, the “3rd Crop Rehabilitation” programme will continue as will the “National food security programme” involving the public and the private sector and society participations [108].

The government policy since 2006 resulted in 2010 in almost a doubling of the total sown area from 162 thousand ha to 315.3 thousand ha (see Annex 16).

Irrigated crops

One of the major issues of intensification of agriculture is the development of irrigated crops on a scientific basis.

Mongolian agriculture is constrained by a short growing seasons and low precipitation. The country's altitude ranges between 560 meters above sea level and 4,374 m. Because of the high altitude, Mongolia's climate is generally colder than in other countries of the same latitude, with mean annual temperatures ranging from -6.2°C in the north to about +4°C in the Gobi desert. Unseasonal frosts, especially in the late spring or early autumn, can dramatically reduce the length of the growing season, which generally ranges from 70 to 130 days, depending on location. [67]

Average annual precipitation varies from about 400 mm in the northern regions to less than 100 mm in the southern Gobi region. Precipitation also varies with altitude, with annual totals higher than 400 mm confined to the mountainous areas where growing seasons are also the shortest. Distribution is strongly seasonal throughout the country, with two-thirds to three-quarters of the annual precipitation occurring during June, July and August.

eWhen considering the relationship between precipitation and crops for the last 40 years, crop yield is directly relaten to precipitation and its distribution. For example, in 1983, 1985, 1988 which were high precipitation years, thn average yield of wheat wae 13.9 c/ha, 14 c/ha, 12.7 c/ha respectively, while in 1979, 1980, 2002 which were drought years, the wheat yield wae 6.2 c/ha, 5.7 c/ha and 4.5 c/ha. The difference is about 2-3 times, which shows that when using irrigation thedyield could be higher. Although Mongolia has fertile soils, rainfall is low, so in the Gobi and desert cannot harvest without irrigation.

The country has an interesting history and tradition of irrigated farming. Development of irrigated farming can be divided in3 periods:

1. Ancient or People's farming till 1911,
2. farming during centralized planned economy period from 1960 till 1990,
3. Free market economy period from 1990

According to scientists such as Bayanchuulgan. B, Shubin. B. F, Baranov. B. E, Simukov. A. D and Gongor. D Mongols have engaged in irrigated farming since ancient times. For instance tools and equipment for farming, excavated at the Khadaas ruin, confirmed that Mongolians have engaged in farming since the 8th century before our calendar. During the 12th and 13th centuries Buir Lake, Khalkh River, the valleys of the Selenge, Kherlen, and Orkhon Rivers, Valley of Bulgan River have been the main places of Mongolian irrigated farming. Traces of ancient irrigation facilities, which were used for (supplementary) irrigation at those times, remain until today. Academian and historian, Dalai.Ch concluded that the Sartagtai Channel of Khovd province might have been excavated in this time also. In the beginning of 20th century, the cultivated area reached to 60-70 hectares by the survey of the Dr Maiskii.E.M.

During the period 1920-1930 after the People's Revolution, the state policies in agriculture have been resolved with irrigation activities. Hydro and horse mills were built in Khangai area through 1942-1943 for the production of wheat flour and 6 hydro mills were in use in Jargalant, Boroo and Bulgan. In 1957 the largest irrigation systems named "first half engineering" covering an area of 17000 hectare were built in Kharkhorin, Zuunkharaa and Erdeneburen [67].

Since 1960s, started to use virgin land for crop farming, the irrigation was focus to plant potato and vegetables in dry regions. After from 1980s, the irrigation activities were focus to plant barley in Gobi and Western provinces, to prepare the fodder plant for animals and to strengthen livestock husbandry and material technical base. The much improvement has done to supervise on the utilization of the irrigation system, make investment, to create the technological management, and to prepare the peasants.

In 1990, irrigation schemes covered a total area of 45.0 thousand ha and areas with flood irrigation covered 16.0 thousand ha. At the national level irrigated agriculture provided 100% of the vegetables and fruits, 20% of the potatoes, 15-18% of cultivated fodder and 2.5 % of the cereals. The number of irrigation schemes used in the above period is shown in *Annex* 17.

During the transition period, many irrigation systems collapsed. Moreover, until 2004 no construction and reconstruction of irrigation systems took place. At the same time, cheap imports from China reduced the demand for domestic agricultural produce. Consequently, the irrigated area decreased from 50 thousand ha to 5.6 thousand ha between 1990 and 2000 [67].

Since 2000 GoM is implementing measures on restore irrigation schemes and support management of irrigation schemes because of which the irrigated area reached to 15.3 thousand ha in 2004, 17.7 thousand ha in 2005 and 19.3 thousand ha in 2006. As a result of the implementation of the "3rd Crop rehabilitation" program in 2010, the number of irrigation schemes reached 394 covering a total area of 37.5 thousand ha. The yield of cereals was 20.3 c/ha, of potato 123 c/ha and of vegetable 131.4 c/ha. That was higher than the yield from rainfed crops, but less than the irrigated yields in other countries. Therefore, in future the irrigation technology needs to be improved. In Annex 18 all irrigated crops and their yields are presented.

In 2008, irrigated agriculture used 91.5 million m^3 of water, in 2010 109.8 million m^3, which was 15.9% of the total water use and 53.6% of the total agriculture water use.

Future development trend

According to a survey by MFALI the future irrigated area could be increased by 43-44 thousand ha. The National Water Programme aims to build reservoirs with volume over 25.0 million m^3 by 2021 and construct or rehabilitate over 10.0 thousand ha irrigated cropland per year. Within these activities the MFALI estimated that for the construction of 34.2 thousand ha new and reconstruction of 10.1 thousand ha of irrigation schemes requires an investment of 18.1 billion MNT.

The "Government policy on Food and Agriculture" aims to harvest 25-30% of wheat and fodders from irrigated area by 2015. The "Sea-buckthorn" program plans to increase the sea-buckthorn plantation to 20 thousand ha.

The "Food Security programme" estimates the Mongolian population will reach 3 million people by 2015. By this time the flour use (according to a 2008 Ministry of Health's food norm's) in Mongolia will be approximately 304 thousand tons increasing to 405 thousand tons by 2021 [59]. The project consultant Mr. G. Davaadorj estimated when converting the 75% of wheat to flour, that in 2015 and 2021 respectively 405 thousand and 540 thousand tons of flour will be required. When also including the seed requirements, 630 thousand and 678 thousand tons of wheat need to be harvested in 2015 and 2021 respectively.

If 30% of this is to be produced from irrigated fields, than 189 thousand tons needs to be grown in 2015 and 203.4 thousand tons in 2021. If the yield per ha from irrigated fields is 35 centner, than in order to collect this amount, need to irrigate 54 thousand ha in 2015 and 58 thousand ha in 2021. Livestock numbers will reach 47 million sheep units in 2015 and 52 million sheep units in 2021, which will require 215 thousand tons of planted forage in 2015 and 440 thousand tons in 2021. For these quantities of green forage and silage 40 thousand hectares has to be planted in 2015 and 60 thousand hectares in 2021. Assuming that 30% of fodder and forage plants is to be grown under irrigation, 12 thousand hectares needs to be planted in 2015 and 18 thousand hectares in 2021. On top of this, aside from potatoes and vegetables, the area under sea-buckthorn needs to be increased to 20,000 hectares, the total area under irrigation needs to reach 124 thousand in 2015 and 137 thousand hectares in 2021 as stated in the "Sea buckthorn" program (Table 17).

Based on this calculation, the water use of the agricultural sector might increase up 4-5 times [59]. However, if during this time, drought and warming increases, the amount of water for irrigation will increase, hence these above calculations might change. Therefore three scenarios were defined for to estimate future water demand.

Table 17. Prospect of Irrigated area

Crop type	Amount of harvest to collect, 000' ton		Field to plant, 000' ha		water use norms, *m^3/ ha*	Water to use, *million m^3/ year*	
	2015	2021	2015	2021		2015	2021
Wheat	189	203	54.0	58.0	2400	129.6	139.2
Planted forage	65	132	12.0	18.0	2900	34.8	52.2
Potatoes	134	144	16.0	17.0	3000	48	51
Vegetables	222	238	15.0	16.0	3200	48	51.2
Fruit	101	104	27.0	28.0	6000	162	168
Total	710.5	821	124.0	137.0	-	422.4	461.6

5.3.3. Agriculture Production

The preliminary estimate of the agricultural production in 2010 was 2016.6 billion MNT at current prices, or 1021.6 billion MNT at constant prices of 2005, a decrease of 15.5% compared to the previous year. Although crop production increased, livestock production reduced by 19.0% due to the dzud.

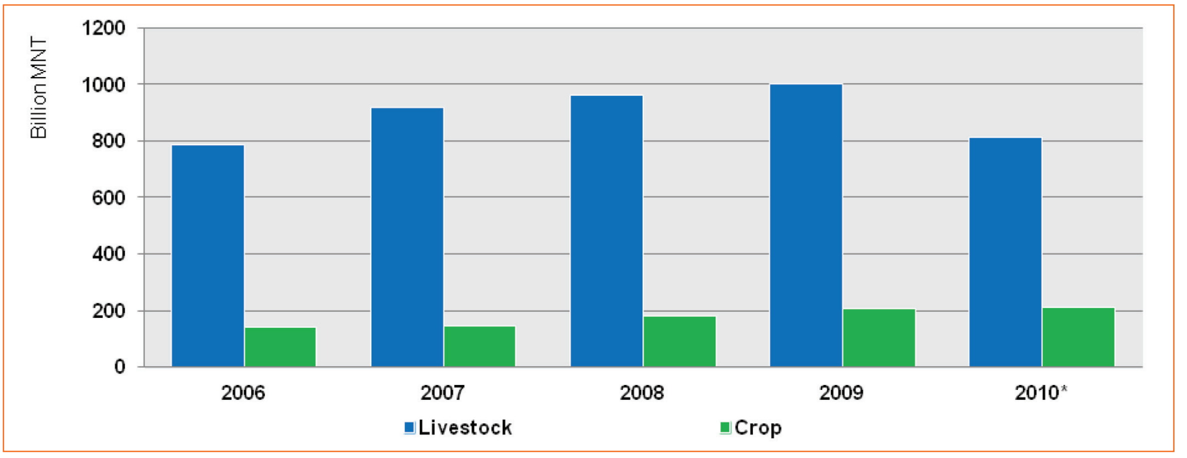

Figure 27. Agriculture production, at 2005 constant prices

Of the total agriculturle production in 2010, 66% came from livestock production and 34% from crop production (see Table 18 and Figure 27).

Table 18. Agriculture sector production, at current prices, billion MNT.

Sector		2006	2007	2008	2009	2010*
Total		981.8	1297.5	1691.7	1737.4	2016.6
Of which	Livestock	834.5	1124.8	1377.1	1307.7	1331.8
	Crop	147.3	172.7	314.6	429.6	684.8

**preliminary data*

Table 19 demonstrates the production of the main agricultural products. Recently, agricultural production has increased due to livestock growth and government policy.

Table 19. Output of main agricultural products volume

Commodities	Unit	2006	2007	2008	2009	2010
Meat, slaughter weight	*000' ton*	170.7	191.2	221.3	264.4	204.4
Hide and skin	*000' pcs*	6 374.0	7 218.4	9 762.4	12722.8	16784.7
Of which: of big animals	*000' pcs*	657.0	667.8	885.5	843.4	1177.4
of small animals	*000' pcs*	5 391.0	6 317.2	7 082.8	10001.4	13327.4
Sheep wool	*000' ton*	15.8	18.2	20.8	22.4	23.5
Cashmere	*000' ton*	4.0	4.9	5.8	6.4	6.3
Milk	*000' ton*	450.1	465.6	457.4	493.7	338.4
Egg	*million pcs*	19.0	46.2	47.9	30.8	47.9
Cereals	*000' ton*	138.6	114.8	212.9	391.7	355.1
Potato	*000' ton*	109.1	114.5	134.8	151.2	168
Vegetables	*000' ton*	70.4	76.4	78.9	78.0	82.3

Export demand for agriculture production is increasing. For example, in 2010 export of meat and meat products amounted to USD 54.6 million, wool and cashmere amounted to USD 183.4 million and hides and skins to USD 3.9 million The export of meat and meat products increased 1.7 times and export of wool and cashmere increased 9.2 times compared to the previous year.

5.4. Industry and Construction

Until 1990, the start of the transition from a centrally planned economy to a market economy, the industrial sector of Mongolia made up about 30% of GNI and was a major employer. Prior to that time the industrial sector was 100% state owned and when compared to the present produced more kinds of products and the sector could avail over high technology facilities. Products were exported mainly to the member countries of the Council for Mutual Economic Assistance.

Early in the transition period the industrial production decreased, and the sectors' GDP dropped from 36% to 20% of the total GDP during the period 1990-2000. In particularly the manufacturing sector experienced high stress and its GDP decreased from 12% to 6% of the total GDP over the period 1995-2000. Along the reduction of the production employment decreased as well. At present the industrial sector of Mongolia is rapidly developing, although the manufacturing sector, is still in poor shape (GoM, 2009). This is contributed to insufficient investments, shortage of raw materials, low technology and high tax, and interest rates.

In 2010, the industrial sector produced 35.6% of the total GDP of which 63.8% was mining and quarrying. Manufacturing produced 8.5% of the total GDP.

The annual industrial production is presented in Table 20 and Figure 28.

Table 20. Industrial production in billion MNT, at current prices

Divisions	2006	2007	2008	2009	2010
Mining and quarrying	1627.6	1938.9	1981.5	2157.9	3150.7
Manufacturing	499.7	877.7	1214.1	1164.4	932.4
Electricity, thermal energy and water supply	199.9	244.0	318.4	351.6	446.3
TOTAL	2327.2	3060.6	3514.0	3673.9	4529.4

Due to the global financial crisis in 2009, production of the economic sectors fell, except for mining and quarrying. In that year production of the industrial sector decreased by 3.3% but in 2010 recovered with a 10% growth including the growth of manufacturing with 11.4%

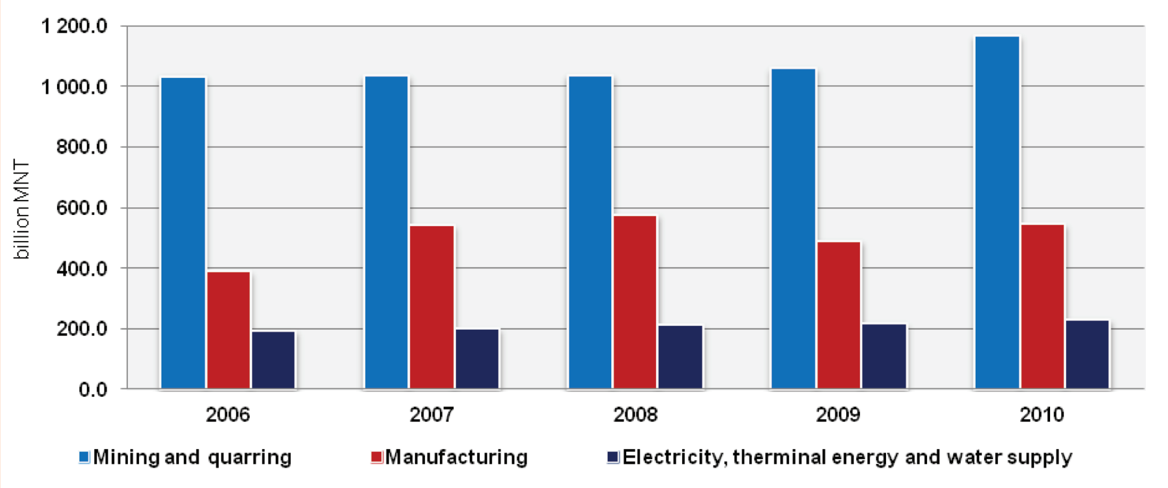

Figure 28. Industrial production, at constant prices of 2005

5.4.1. Mining and Quarrying

Current situation[17]

In the course of the country's policy to support export-orientated industries, the mining industry is developing as the backbone and leading sector of the country's economy.

Mining and quarrying: Currently, there are over 230 economic entities operating in the mineral resource business which can be split up in following:

- 3 copper-molybdenum mining
- 103 gold mining
- 38 coal mining
- 1 zinc mining
- 3 assorted metallurgy mining
- 5 tungsten steel mining
- 2 tin mining
- 9 iron mining
- 24 fluoride mining
- 42 construction materials mining entities.

According to a report of the Mineral Resource Authority, a total of 4744 valid licenses had been issued covering 39,454.9 thousand ha exploitation and exploration sites by the end of 2009. In first half of 2011 the number of valid licenses had decreased to 3965 covering a total area of 24,369.9 thousand ha. Exploitation and exploration sites for mineral resources occupied 15.6% of the territory of Mongolia. For more details on the number of exploitation and exploration licenses please see *Annex* 19 and *Annex* 20.

Statistical records of 2010 indicate that the mining sector produced 22.7% of the GDP, or 66.7% of the gross industrial production and 81% of the gross export production while it generates over 40% of the state and local budget revenues. The sector employs 34.1

[17] The chapter has includes data and information from "Report by Mr. U. Borchuluun, Policy Analyst Mineral Resources and Energy"

thousand people. The contribution from the mining sector to the country's economy is steadily rising as can be seen in *Table 21*.

Table 21. Percentage of the Mining sector in the Mongolian Economy at current prices

Production	2006	2007	2008	2009	2010
GDP	30.0	27.4	20.6	19.8	22.7
Industry	69.9	63.4	56.4	62.7	66.7
Export	67.9	66.8	60.3	66.4	81.0

Recently the mining and quarrying significantly increased and in 2010, the sector's total output was 3150.7 billion MNT at current prices (*Table 22*). For the past 3 years coal mining has rapidly increased and in 2010 reached at 32.9% of the mining and quarrying, while mining of metal ores stood at 57%, extraction of crude oil at 6.5% and other mining quarrying at 3.6% *Figure 29*. The mining and quarrying production are directly depending on world market demand, as we can see for example of the coal.

Table 22. Gross mining and quarrying production in billion MNT, at current prices

Division	2006	2007	2008	2009	2010
Coal mining	104.6	147.5	210.9	482.9	1 037.4
Extraction of crude petroleum	19.3	31.7	45.0	147.3	203.4
Mining of metal ores	1 459.9	1 710.7	1 655.5	1 439.1	1 796.1
Other mining and quarrying	43.7	49.0	70.0	88.7	113.8
Total	1 627.6	1 938.9	1 981.5	2 157.9	3 150.7

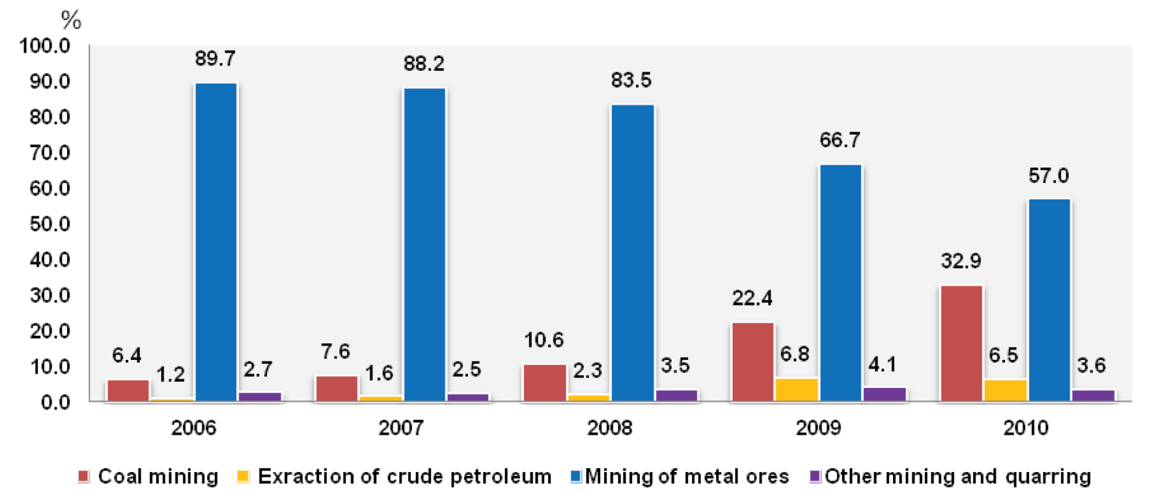

Figure 29. Composition of the mining sector

The mining and quarrying outputs are presented in *Table 23*.

Table 23. Outputs of main mining production by volume

Commodities	unit	2006	2007	2008	2009	2010	2010/ 2008, %
Coal	*000' ton*	8 074.0	9 237.6	9 691.6	13 163.9	25 246.4	260.5
Crude oil	*000' barrel*	376.5	850.1	1 174.2	1 870.0	2 181.4	185.8
Copper concentrate	*000' ton*	537.7	543.1	525.3	533.1	522.0	99.4

Commodities	unit	2006	2007	2008	2009	2010	2010/ 2008, %
Copper concentrate with 35%	*000' ton*	370.5	371.9	362.3	370.9	357.1	98.6
Molybdenum concentrate	*ton*	3 022.0	4 002.0	3 795.0	5 263.6	4 348.0	114.6
Molybdenum concentrate with 47%	*ton*	2 987.0	4 209.1	4 042.0	5 125.4	4 677.1	115.7
Gold	*kg*	22 561.3	17 472.5	15 183.8	9 803.3	6 037.1	39.8
Iron ore	*000' ton*	180.0	265.1	1 387.4	1 379.0	3 203.2	230.9
Fluor spar concentrate	*000' ton*	137.6	131.8	142.9	115.3	140.7	98.5
Zinc concentrate	*000' ton*	109.9	154.7	143.6	141.5	112.6	78.4
Tungsten concentrate	*ton*	85.0	244.5	141.9	38.6	19.9	14.0
Crushed stone	*000' ton*	134.3	144.2	103.3	123.4	101.1	97.9

Currently, there are seven sites for extraction of crude oil and five joint companies are working according to the Production Sharing Agreement adopted by GoM that are investing significantly. Between 1994 until March 2010 2-dimension vibration surveys and 3-dimension vibration surveys were conducted in an 18,788 km^2 area and a 5,914.9 km^2 area respectively within the oil exploration areas that are included in the "Agreement of sharing products". Although Mongolia has extracted crude oil, domestic needs of petroleum are 100% provided for from import. For example in 2010 2070.8 thousand barrels (282 thousand mt) crude oil was exported, while 805.6 thousand ton petrol, diesel, jet fuel and mazut was imported. The GoM seeks opportunities to produce fuels in the country and satisfy domestic needs.

At present, over 170 licenses have been issued for coal mining, of which 105 are active. In the coal sector there are 21 state and local government-owned companies operating such as "Baganuur", "Shivee Ovoo", "Tavan Tolgoi", "Avanteeg" and "Mogoi Gol" etc. and about 150 entities are private property coal extraction companies. In 2010, a total of 25.2 million ton coal was extracted of which 16.7 million t was exported. Due to growing export to China coal extraction increased by over 2 times compared to the previous year. Main coal exporters are "Tavan Tolgoi" co., "Chinkhua-Nariin Sukhait", "MAK", "South Gobi Sands", "Tavan Tolgoi Trans", and "Energy Resource" LLC.

In October 2009 the GoM endorsed the Oyu Tolgoi Investment Agreement with Ivanhoe Mines Mongolia inc and Rio Tinto. That marked the beginning of including the big mining deposits in the economic cycle of Mongolia and to engage large foreign investors in mining. The Oyu Tolgoi exploitation is expected to employ about 10 thousand people and establish about 200 small enterprises. In 2010, the GoM decided to establish "Erdenes Tavan Tolgoi" co. and 10% of the total shares were given free to every citizen of Mongolia in ownership. Although this decision raised many disputes, it is having some importance, for example to give understanding to every citizen about rights and responsibilities of ownership of mineral resources. In addition, shareholders can use wisely these shares.

Mining processing and heavy industry

In Mongolia, the mining and quarrying sector is developing intensively whereas heavy industries, except for concentrators are rare. In 2010, production reached 142.8 billion MNT. which was 3.9% of the gross industrial production and 12.3% of manufacturing. The output of mining processing and heavy industry is shown in *Table 24*.

Table 24. Output of mining products, heavy industry, volume

Commodities	unit	2006	2007	2008	2009	2010
Copper, 99%	*ton*	2618.4	3006.5	2586.6	2470.1	2746.2
Metal steel	*000' ton*	70.0	80.4	81.4	50.1	64.2
Metal foundries	*000' ton*	54.2	67.4	75.9	37.7	61.8
Electrical conductor wire	*ton*	221.2	294.8	705.8	298.5	147.3
Cement	*000' ton*	140.8	179.8	269.3	234.8	322.5
Lime	*000' ton*	60.4	43.3	54.8	43.1	50.2

The "Erdenet" company was established in 1978 with an annual capacity of dressing 25-25.6 million ton ore and producing 530.0 thous t of 23.5% concentrate copper and 3 thous ton concentrate molybdenum (49-51% Mo). It has been the core of the nonferrous metallurgical enterprises of Mongolia. For example Erdenet produces 30% of the gross export production of Mongolia The Tumutiin-Ovoo zinc concentrate company, which is secondary largest enterprise of Mongolia, was established in 2005 with a capacity to produce 300 thousand ton 15% zinc concentrate per year and 70 thousand ton 50% zinc concentrate. This company produces about 7% of the gross export production or 9% of the gross mining output or 5% of the total industrial output.

Recently implementation started of some projects for production of iron ore concentrate and separation of iron. For example, the Berengroup LLT established a concentrator for the Tayannuur iron ore deposits of Arkhangai aimags' Tuvshruulekh soum and an enterprise for separation of iron in Erdenet city.

Heavy industry: At present Mongolia has some 10 metallurgical enterprises like "Erdmin" joint Company, Copper Cord Company and Metallurgy of Darkhan, etc. and about 50 machine, agricultural machine tool and equipment repair industries

The GoM aims to exploit new mineral deposits, to introduce technological renovations to operating industries and to expand to production of end products. Specific goals have been set until 2021 such as establishing industries for copper melting, increasing cathode copper production and copper concentration, building industries for molybdenum concentration and iron concentration. In addition, the GoM planned to establish a metallurgy complex, a manufacturing plant for phosphoric fertilizer and an uranium concentrator. A study has been conducted on options for alternative sources of energy for the production of end-products and use deposits of rare earth by 2021. The long-term goal of Mongolia is to establish industries of end mining-products.

Water is used by the mining industry to separate ore from rock, to cool drills, to wash the ore during processing and to carry off unwanted material. Usually, the mining industry requires most water of all the industrial sectors and has a big impact on the available water resources in Mongolia, even though the water reuse percentage is high (~70%).

The mining and quarrying is the biggest single water user. In 2010, the mining sector has used 35.1 million m^3 water, which had decreased from 2008, by 46.8%; as a result of the implementation of the Law on "Prohibiting minerals exploration and mining in protected zones of sources of rivers which originate streams of the rivers, drainage basins and forest areas" since 2009. Related to that some mining production reduced as well, in particular gold mining although global gold prices were moving upward.

For the mining sector to continue its growth, new mining projects need to be commissioned. The capital costs of new projects are heavily depending on the proximity of roads and/or railway lines, water and power infrastructure. Interesting sites from a geological point of view can become uneconomic when the costs of providing the necessary infrastructure are too high. It is expected that almost all medium and large mining developments that are expected in Mongolia will require significant new power, water, and transportation infrastructure.[18]

Therefore, infrastructure development is of imminent importance for the development of the mining industry. Since the mining industry attracts significant private investments and because the developed infrastructure at first mainly benefits the mining industry, it could be argued whether the government has to invest in (all) the infrastructure for mining activities; It could be considered to leave that to the mining companies[19] themselves, especially with the current high prices for the minerals and current taxation condition making high investments still financially feasible.

The development of the mining industry also largely depends on the world prices of the minerals. Figure 30 shows the developments of mineral prices between 2006 and 2011 showing an gradual recovery again after the steep dip in 2008.

Source: IMF, International financial statistics online database 2011

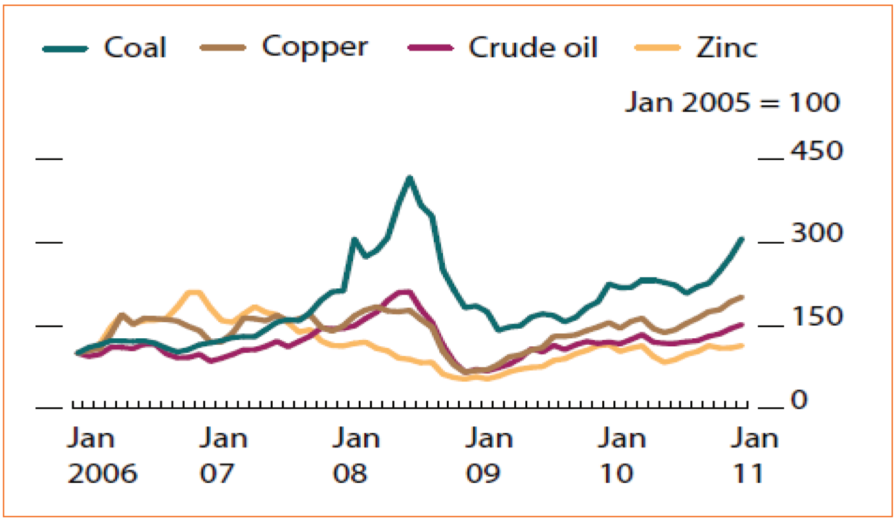

Figure 30. World market prices of mineral

Future Development Trend of Mining Sector

The policy of the mineral resources sector of the GoM is to promote a sustainable development of the economy and to increasercontrom, to ensure the national rights and to increase people's living standards by developing responsible mining and heavy industries, which produce final products. The government pland to conduct periodic exploration of the geological formations of the Mongolian territory.

The policy paper on the development of mining and processing industries emphasizes that exploiting mineral deposits of strategic importance is the first priority. The policy paper further states that proposals shall be made, decided upon and implemented about its 39 mineral resource deposits approved by 2nd annex of the State Great Khural resolution # 27. (*Table 25, Figure 31, Annex 21*)

18 Worldbank – PPIAF, Rethinking the delivery of infrastructure services in Mongolia, 2007
19 UNDP, Mongolia Common Country Assessment 2007-2011, 2005

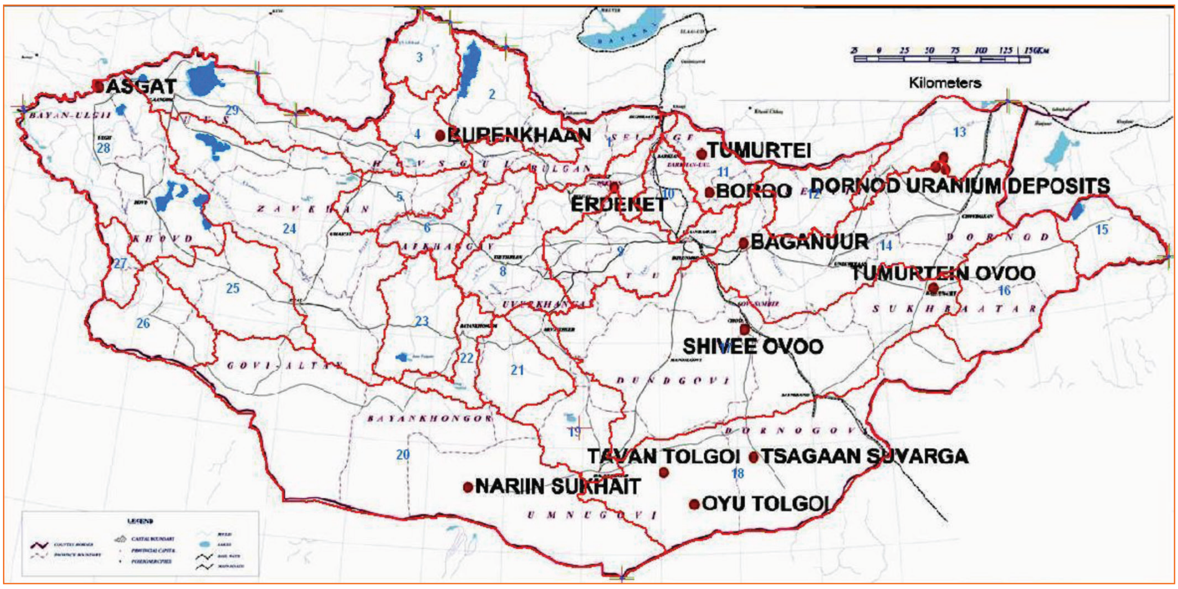

Figure 31. Map with locations of strategically important mineral deposits

Table 25. List of strategically important mineral deposits approved by the Mongolian State Great Khural

№	Name of Deposit	Location: province, soum	Resource type	unit	volume
1	Tavan Tolgoi	Umnogobi, Tsogttsetsii	Coals	*Million ton*	6420.0
2	Nariin Sukhait	Umnogobi, Gurvantes	Coals	*Million ton*	90.8
3	Baganuur	Ulaanbaatar, Baganuur	Brown coals	*Million ton*	512.8
4	Shivee Ovoo	Gobisumber, Shivee Ovoo	Brown coals	*Million ton*	564
5	Mardai	Dornod, Dashbalbar	Uranium	*ton*	1104
6	Dornod	Dornod, Dashbalbar	Uranium	*ton*	58933
7	Gurvanbulag	Dornod, Dashbalbar	Uranium	*ton*	16073
8	Tomortei	Selenge, Khuder	Iron ore	*Million ton*	229.3
9	Oyu Tolgoi	Umnogobi, Khanbogd	Copper Gold Molybdenum Silver	*Million ton* *ton* *Million ton* *ton*	45 1838 401.0 12000
10	Tsagaan Suvarga	Dornogobi, Mandakh	Copper Molybdenum	*Million ton* *000' ton.*	1.28 43.6
11	Erdenet	Orkhon, Erdenet	Copper Molybdenum	*Million ton* *000' ton*	3.2 90
12	Burenkhaan	Khuvsgul, Burentogtokh Alag Erene	Phosphorus	*Million ton*	40.5
13	Boroo	Selenge, Bayangol	Gold	*ton*	22
14	Tomortein Ovoo	Sukhbaatar, Bukhbaatar	Zinc	*000' ton*	820
15	Asgat	Bayan Ulgii, Nogoon Nuur	Silver Copper	*ton* *000' ton*	2247 72.6

The major mining projects to be implemented in the near future are the following:

Copper

- Continue the modernization and renovation of the Erdenet Corporation, to produce pure copper, molybdenum and sulfuric acid through processing copper and molybdenum concentration.

- Increase production of the cathode copper and improve processing capacity of the low concentration copper.
- Establish the Oyu Tolgoi copper mining and concentrate plant with capacity of 320-350 thousand ton per year.

Gold

- Launch the extraction and operation of gold deposits at Gatsuurt, Bayan Airag and others. Advanced machinery and technology have to be introduced in gold mining industries to minimize waste, operate environmentally friendly and to maximize the utilization of mineral resources.
- Organize measures to apply, test and transfer the technologies of refining of low concentration gold into gold mining.
- Provide possibility of establishing a gold refining plant.

Fluorspar

- Modernization and renovation of the Bor Undur mining industry and improve competitiveness in the international markets and boost export revenue by increasing the marketing level and the range of products.

Coal

Coal extraction and processing will be implemented within the framework of the "Coal" program:

- Expand the utilization of the Tavan Tolgoi coal deposit and build a thermal power plant and industry for coal concentration and processing on the basis of the Tavan Tolgoi coal deposit.
- Launch the development of coal deposits in the Choir-Nyalga basin and build a power, thermal and liquid fuel plant.

Iron

- Build iron ore extraction, concentration and processing facilities at iron ore deposits like Tumurtei, Khust Uul, Bayan Gol, Tumor Tolgoi and Bargilt of which the exploitation reserves are earmarked for an accelerate development of the ferrous metallurgy industry.

Uranium

- According to the Government policy on radioactive mineral resources, a separate program on uranium will be developed and implemented.

Rare earth

- Provide support to the extraction of the Lug River and the Mushgia Khudag rare earth deposits, which is used for electronic and high technology purposes.

Other metals

- Increase the exploitation of reserves of other metal deposits like Tumurtiin Ovoo, Ulaan and Tsav. Besides that build industries for processing zinc concentration, producing metal zinc and separating other associated minerals such as lead, gold, silver and iron.
- Establish industries, equipped with modern technologies, for extraction and

concentration of molybdenum at the Ariin Nuur deposit. To meet domestic needs of raw materials for the production of electrical and technical products, a study is conducted on the possibility to produce pure tin by relying on rehabilitation of a previously extracted tin deposit.

Tungsten steel

- Increase the production of tungsten steel through establishing modern technological industry.

Silver:

- According to regional comprehensive development program, conduct a study and make recommendations and expertise on the extraction of the Asgat silver deposit, and support investors on recommendations of use of the deposit.

Phosphoric

- Elaborate a proposal to develop a group of phosphoric deposits at Burenkhaan to manufacture phosphoric fertilizers and other products, provide support to improve investment environment.

Other minerals

- The government will provide support for introducing and using environmentally friendly and less waste producing technologies for the extraction and utilization of mineral deposits such as limestone, gypsum, benthonic, sand, gravels, brick-earth, marble and granite deposits by increasing the investments to the heavy industry and construction sector.
- Conduct a study on extracting and processing benthonic to reduce its import.

For the development of heavy industry and production of final products, the following projects will be implemented:

Development of industries for ferrous metal

Establish a metallurgy complex at iron ore deposits in the Darkhan and Selenge Region, where the infrastructure is well developed, and in Dornogobi, Dundgobi and Khentii provinces. The processing and sale of final products will be expanded.

Development of industries for base metal

Establish a copper smelting plant of Erdenet Corporation. The exploitation of strategic deposits such as Oyu Tolgoi and Tsagaan Suvarga will be intensified and small and medium size concentration of industries will be established.

Processing precious metal

Establish industries for purifying gold and other precious metals.

Coal deep processing and energy industry

Establish a thermal electricity plant with high capacity and plants for extracting liquid fuel from coal and producing coke relying upon the Tavan Tolgoi and other coal deposits.

Coke Chemical industry

Establish chemical industry mainly based on the Tavan Tolgoi coking coal deposits. Develop medium scale chemical industries by using sulfuric acid-ammonia, benzyl and epoxy discharged from the coking coal and chemical industry. Moreover, develop a smokeless fuel plant, which will use carbonic acid from the coking coal and chemical industry.

Industry for construction materials

Domestic reserves can fully meet the needs of construction materials and substitute import. By increasing the capacity of the cement and chalk industry the domestic needs of cement and chalk can also be fully satisfied.

Chemical industry

Develop accompanied chemistry industries such as petroleum and coal processing, copper melting and processing of some minerals.

The development of new mines will result in an increase in water demand. This mostly concerns water resources here in the main regions for mining being the Southern Gobi region, Dornod region, Darkhan-Selenge region, Western region, Sainshand-Shivee ovoo region and Ulaanbaatar region. For example, the development of two prominent deposits, which are located in Southern Mongolia Oyu Tolgoi[20] and Tavan Tolgoi[21] poses serious challenges to the water sector of Southern Mongolia. The water demand in Southern Mongolia is expected to increase seven fold by 2020, whereas water availability is limited.[22]

Main issues to be considered for water management and water consumers

Taking into account the Government policy on mining sector development, world market needs, foreign investors, current mineral resources exploration and operation activities by license owners of mineral resource utilization it is expected that the following industrial complexes will be established with respect to the mineral resources sector:

- Mining extraction and processing industries are expected to be built in the near future in association with the Tavan Tolgoi coke-coal deposit, the Oyu Tolgoi and the Tsagaan Suvarga copper deposits in the South Gobi Region.
- The construction of an iron ore extraction and concentration industry in association with the Tumurtei, Khust Uul, Bayan Gol, and Tumur Tolgoi deposits in the Darkhan and Selenge Region. In the future, a ferrous metal industry will also be established.
- Long-term contracts for the extraction of the Mardai, Gurvanbulag, and Dornod uranium deposits in the Dornod Region are currently being negotiated with investors.
- Enhance the capacity of the associated metal industries of Tumurtei Ovoo, Ulaan and Tsav and build a new industry for acquiring pure zinc, lead and recovery of other associated minerals.
- The Government intends to extract the Asgat silver deposit and to provide support for the extraction operations of the Ulaan Uul, Khovd River and Tsunkheg tungsten steel deposits in the Western region.
- Extract and exploit the gold deposits of Gatsuurt and Bayan-Airag.
- The Government also intends to establish deep processing industries of

[20] 'gold and copper, scheduled to open in 2013', ADB, Mongolia Development Outlook, 2011

[21] 'the largest undeveloped coalfields in the world, being able to produce 15 million tons of coal per year', ADB, Mongolia Development Outlook, 2011

[22] Eurasia capital, Infrastructure in Mongolia – challenges & opportunities, 2009

minerals and to produce pure copper, molybdenum oxide and other associated elements based on products from large mining industries such as the Erdenet Corporation.

According to policy documents on the mineral resource and energy sector, water use is expected to increase in the near future and the following regions are likely to face the highest increase in water demand:

1. South Gobi Region (Mining extraction and processing industries associated to coal, copper, gold deposits and infrastructure related to mining)
2. Dornod Region (Industries for uranium, various metals and petroleum and related infrastructure)
3. Darkhan-Selenge Region (Industries for gold and ferrous metals)
4. Western Region (industries for silver, tungsten steel, iron and coal)
5. Sainshand-Shivee Ovoo Region (Industry, petroleum, zeolite, fluorspar and coal)
6. Ulaanbaatar Region (Construction, power plants and industries)

Prospective projects to be implemented in the Regions are shown on the map in *Figure 32*.

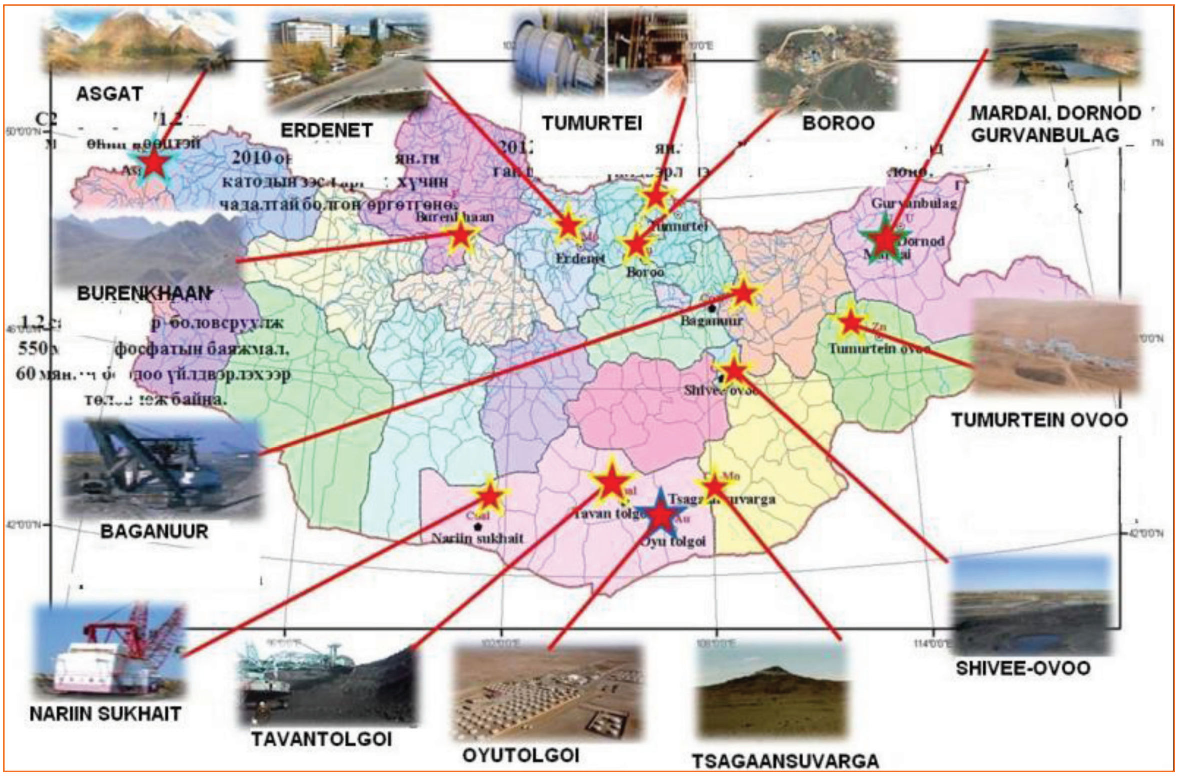

Figure 32. Projects on establishing mining industries based on strategically important mineral resource deposits

The Government of Mongolia needs to choose the most appropriate development of water supply sources necessary for the implementation of the mining industries projects.

In the context ofMIWRM, attention has to be paid to the following aspects:

- Mining industries have to conduct a resource assessment of their water sources and an organization mandated by the government will issue permits to use water.

- To cover all industries in the monitoring, local administration units will be involved in the monitoring process and installation of water meters,
- The development of water use fee and pollution fee mechanisms. To encourage industries to use modern and advanced technology to recycle water efficiently through water demand management tools, like water pricing, imposing penalties and fines on industries that use obsolete technologies for extraction, consume water resources inefficiently, polluting water resources and negatively affecting the water eco-system,
- Update the water use norms,
- Many mines need dewatering, which reduces the groundwater level, in order to expose the ore body. Lowering the groundwater level can negatively affect the aquifer, the soil and the vegetation cover. Therefore, an appropriate water fee on pumped groundwater for the above mentioned purpose has to be defined.

5.4.2. Electricity production

Mongolia receives about 80% of its electricity needs from TPP, 10% from import, 3% from HPP and 7% from renewable and other sources.

In 2010, the electricity sector produced 4312.8 million kWh electricity, 8362.5 thousand Gcal thermo energy and imported 262.9 million kWh electricity (*Table 26*). As of 2010, the total production reached 403.8 billion MNT at current prices, which was 8.5% of the total industrial output.

Table 26. Electricity production and import

Type of production		unit	2006	2007	2008	2009	2010
Domestic	Electricity	*Million kWt.h*	3 544.2	3 700.7	4 000.6	4 038.8	4312.8
	Thermo energy	*000' Gcal*	7 850.4	7 723.5	7 759.6	8 320.5	8362.5
	Production, at current prices	*Billion MNT*	175.7	215.0	270.2	311.9	403.8
Imported electricity		*Million kWh*	241.8	207.6	197.6	156.5	262.9
Share of the import of the total electricity production		%	6.4	5.3	4.7	3.7	5.7

The thermal electricity plants uss water for cooling, whereas hydropower plants uss water to produce the electro energy (see Figure 33).

The energy sector uses a big amount of water. In 2010, over 30 million m^3 was used forlthermal electro energy and about one billion m^3 for hydro energy. Water use for hydro energy and most part of water use for the thermal energy are non-consumptive. Water use and demand trends are presented in *Table* 27.

Figure 34 shows the energy needs and production of the Central energy system. The demand for energy in Mongolia will significantly increase due to implementation of big mining projects, economic development and population growth. There is a sufficient amount of energy resources in Mongolia to meet that demand. In response to the growing energy demand, the GoM recently decided to build the fifth TPP for Ulaanbaatar.

Only the inclusion of 5^{th} TPP and Ukhaa khudag TPP will increase the water use of the sector to 207.5 million m^3 per year by 2015 and when assuming a growth rate of 6% per year the sector's water use will reach 230.8 million m^3 in 2021.

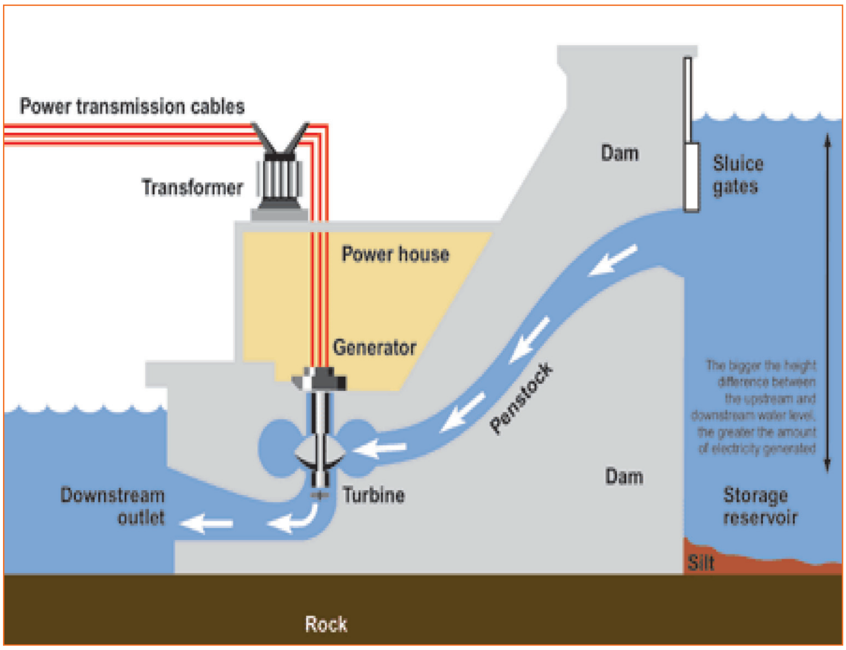

Figure 33. Principle of hydropower generation

Table 27. Capacity of Power Plants, water use

Power plants	Capacity				Water use, *million m³/year*				
	Electro energy, *MWh*		Thermal energy, *Gkal.hour*		2008	2009	2010	2015	2021
	capacity	current	capacity	current					
TPP-2	24	21.5	93.5	93.5	2	2.1	2.1	0	0
TPP-3	148	136	570	570	9.4	9.5	9.5		
TPP-4	540	560	1185	1185	13.7	10.4	10.9	11.9	12
Darkhan TPP	48	48	290	290	3.9	3.9	3.9	4.1	4.5
Erdenet TPP	36	28.8	193.5	193.5	1.2	1.3	1.5	2.5	2.7
Dornod TPP	36	36	173.5	150	2.9	3	3.1	3.2	3.3
Dalanzadgad TPP	6	5.4	7	2	0.8	0.9	0.9	1.1	1.5
Durgun HPP	12	12			170.2	~1000			
Taishir HPP	11	11							
TEPP-5	300		700					9.1	12
Ukhaa khudag TPP								1.2	1.3
Total of TPP					33.9	31.1	31.9	33.1	37.3
Total of HPP	23	23	0	0	170.2	170.2	170.2	170.2	170.2
Total	1184	881.7	3212.5	2484	204.1	201.3	202.1	203.3	207.5

Source: www.mmre.energy.mn

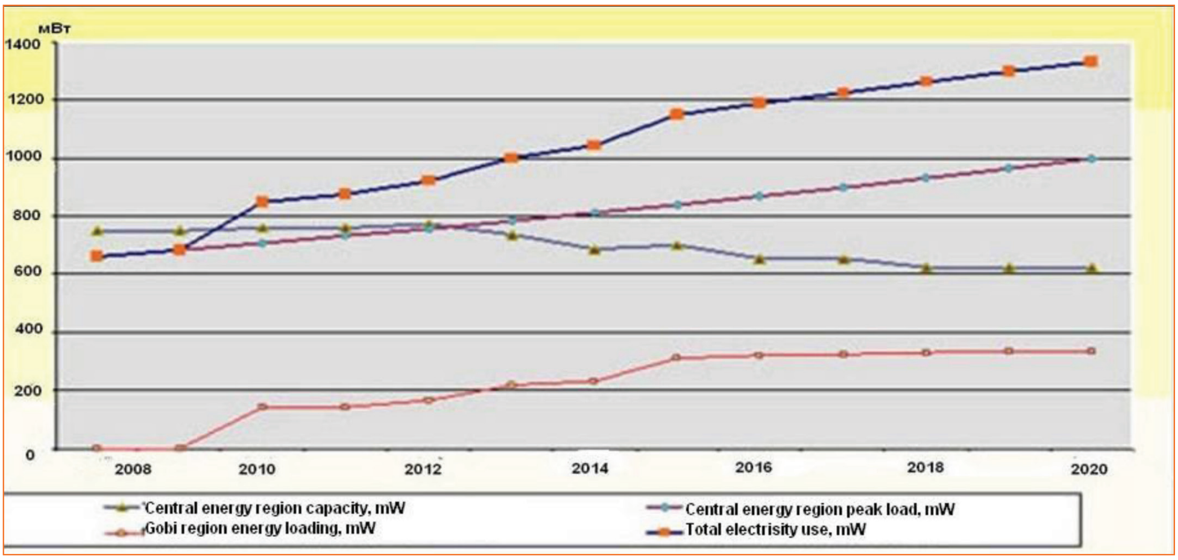

Figure 34. Central region energy systems production and projections.

Hydro Power Plants

Mongolia also uses hydropower plants for the power generation, for example thonDurgun and Taishir HPPs and micro HPPs ie some soums. HPPs are mostly concentrated in Western Mongolia with plans having a capacity ranging from 100 kW to 300 MW. Mongolia produces sufficient hydro energy to satisfy some mines and other needs. However, a major complicating factor is that many rivers freezr during winter.

Table 28. HPPs of Mongolia

No	Name	Capacity [KW]	Start year	Comment
1	Kharkhorin	560	1959	Not working
2	Undurkhangai	200	1989	Turbine-out of order, no electricity line
3	Guulin	400	1998	Seasonally
4	Mankhan	150	1999	Seasonally, Connected to the line booster
5	Munkhkhairkhan	150	2003	Seasonally, Connected to the line booster
6	Bogdiin gol	2000		Seasonally
7	Tosontsengel	375	2006	Seasonally
8	Uyench	930	2006	Seasonally
9	Erdenebulgan	200	2006	Seasonally
10	Zavkhanmandal	110	2009	Seasonally
11	Tsetsen-uul	150	2009	Seasonally

Coal reserves

Mongolia is estimated to hold more than150 tril.ton of coal and over 20 tril.ton of this has been confirmed by detailed exploration (See *Annex 22*). According to studies, over 200 coal deposits are discovered, located in different regions through the country's territory, in around 50 of which exploration and preliminary assessments have been conducted. Currently, some 40 coal deposits are exploited. At present, the coal production in Mongolia is sufficient to meet the domestic demand and since 2003 coal is exported to China (*Figure 35*).

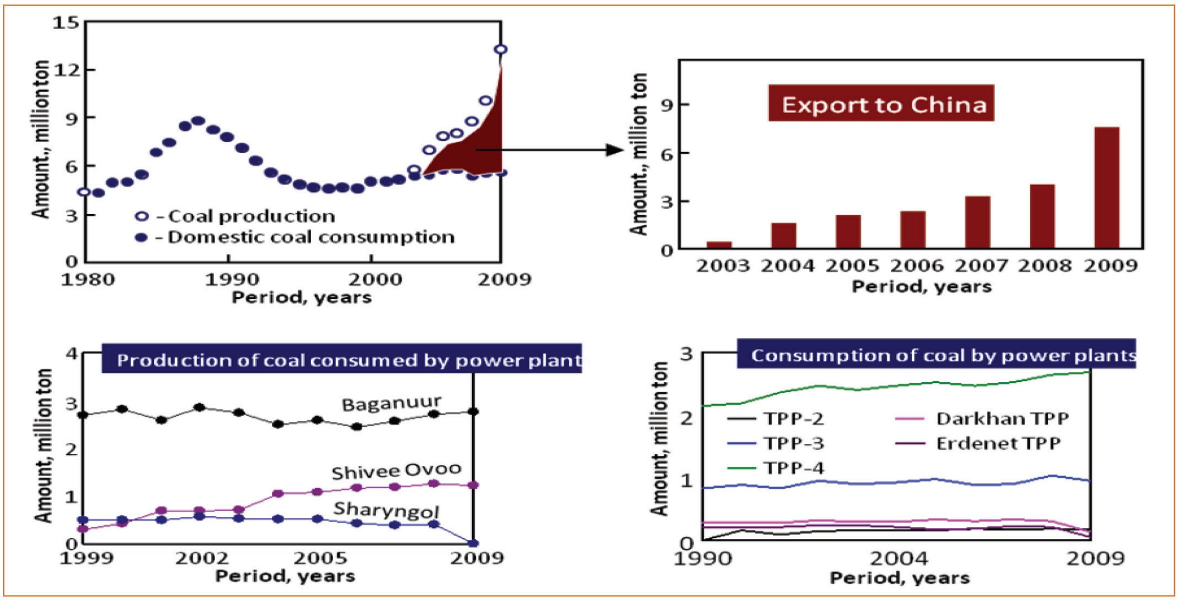

Figure 35. National consumption and export of coal

Coal mining by region is as follows:

- The Western Region holds only a few coal deposits of which some are currently under exploitation, such as Nuurst Khotgor, Khar Tarvagatai and Khoshoot.
- In the Khangai Region there are several coal mines under exploitation, in Saikhan Ovoo of the Bulgan province, Jinst of the Bayankhongor province, Mogoin Gol of the Khuvsgul province and the Bayanteeg coal mine in the Uvurkhangai province.
- In the Tuv Region there are comparatively many coal deposits and the ones under exploitation in this region are Tavan Tolgoi, Baganuur, Shivee Ovoo, Tevshiin Gobi, Alagtogoo and Khangai.
- The Aduunchuluun coal deposit and the Tal Bulag small scale coal deposit are under exploitation in the Eastern Region.

Oil and gas reserves

Petroleum explorations were carried out in the Eastern and Gobi regions in Mongolia and a few reserves were found. Natural gas reserves have not been explored yet.

Renewable energy resources:

- According to surveys on hydropower, Mongolia has about 3500 rivers totally with 60 thousand km and their energy resource is 5700 MWh. There are possibilities for the near and mid-term future to establish and operate hydropower plants in the Western and Khangai Regions with a total capacity of 700 MW.
- Most parts of Mongolia have 270-300 sunny days annually. The average annual period of sun light is 2250-3300 hours and the average annual solar radiation amounts to around 1400 kWh/m2 and the intensity of solar radiation equals 4.3-4.7 kWh/m2 per day.
- Wind energy resources of Mongolia, are calculated at 836.8 tril.kWh based on an estimated 3500-4600 wind hours per year.

Nuclear energy:

Mongolia has some uranium reserves. However, use of the uranium and nuclear energy is under discussion.

Geothermal energy:

There is some geothermal energy reserve, however a study on this field is lacking.

Future development trend of fuel and energy sector

Foremost, there is a need to connect a number of soums to the electricity network and the following soums will be connected:

- Bayan-Ovoo, Khanbogd and Tsogttsetsii of Umnugobi aimag; Matad of Dornod in 2011-2015,
- Bayan-Undur, Bayantsgaan and Shinejinst of Bayankhongor; Durviuljin and Urgamal of Zavkhan; Altai, Bugat and Tseel of Gobi-Altai; Manlai of Umnugobi; Khatanbulag and Mandakh of Dornogobi in 2015-2020.

To satisfy the national energy demand from domestic sources and to export energy to China, additional large power plants are needed and the use of renewable energy has to be increased.

Source: APCTT-UNESCAP, Renewable Energy Report, Ulaanbaatar-2007

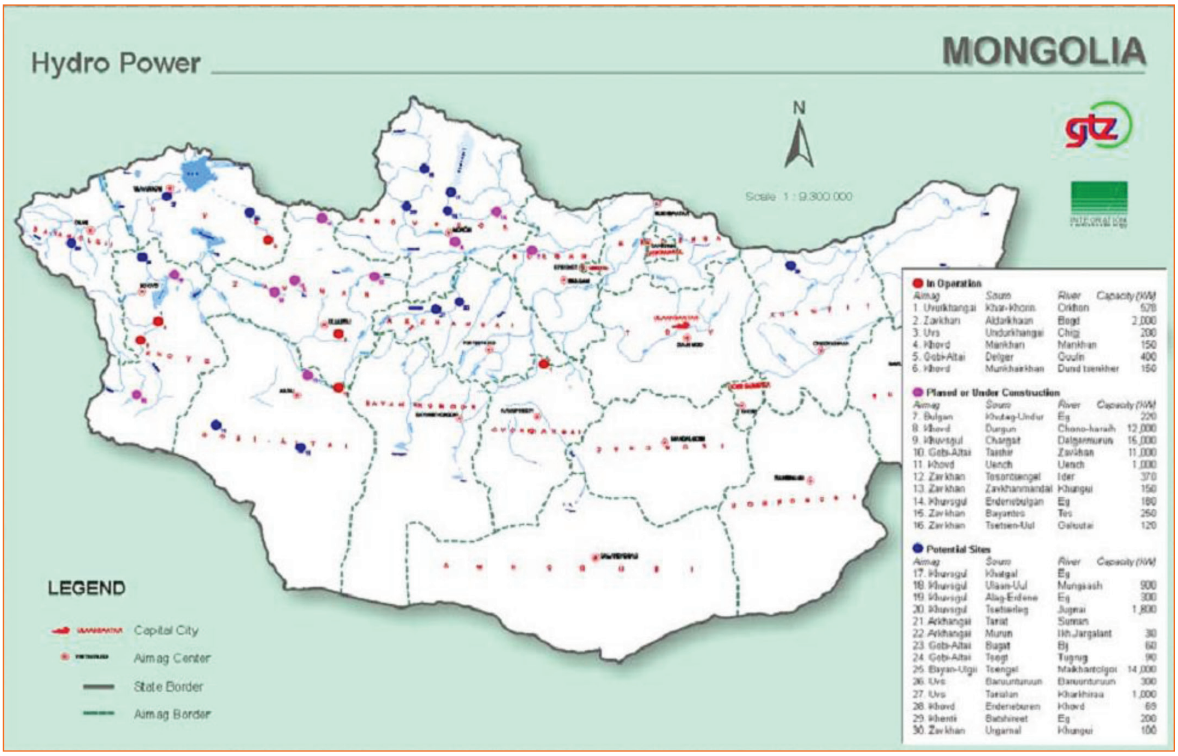

Figure 36. Current and planned HPPs of Mongolia

The Government policies for the energy sector include the following measures and projects to be implemented to achieve the goals for the future:

- Over the past years, peak hour energy loading in the Tuv Region has been increased annually by 3% and it is expected that this trend will continue towards 2020 and the additional demand for energy will reach to 700 MW. Therefore, it is necessary to build and bring on line new power plants for electricity and heat generation with a capacity of at least 100 MW in Ulaanbaatar City.

- To provide the South Gobi region users with electricity the Ulaanbaatar-Mandalgobi-Tavan Tolgoi-Oyu Tolgoi electricity line and substations will be built.
- To increase the stability and efficiency of the energy system in the Eastern Region, the capacity of the Dornod electricity power plant will be enhanced.
- A power plant with a capacity of no less than 300MW will be built based on the Tavan Tolgoi mining deposit, the power plant will be connected to the central power system.
- Build an electricity generating power plant with a high capacity for exporting electricity. The Shivee Ovoo power plant with a capacity of 3600 MW will be built in 2012. In the future, a new power plant is planned with a capacity of 7200 MW on the basis of 2 coal deposits. Therefore, the total capacity will increase by 10800 MW.
- Build a hydro-electric power plant with 220 MW capacity on the Eg River. This power plant will be connected to the central power system by a 220 KV electricity line.
- Aproposal to build a hydropower plant with a capacity of 50 MW in the Tuv Region is to be preapred.
- The Darkhan and Erdenet power plants will be renovated and expanded.
- Build a fuel, energy and coal chemistry complex at the Choir-Nyalga coal deposit and export the electricity.
- A 110 KV electricity line is to be installed from the sub-station at Bayankhongor aimag to Taishir hydro-electric power plant, based on the future power plant with a capacity of 15-20MW at the Bayanteeg coal deposit in Uvurkhangai province.
- To enhance energy security of the central energy supply covering the Zavkhan and Gobi-Altai provinces and to provide for there energy needs the hydroelectric power plants on the Delger and Chargait Rivers and the thermo power plant will be built on the basis of the Mogoi Gol coal deposit and the 110 KV electricity line to Uliastai will be installed.
- The building of thermo power plants at Achit Lake by using the Nuurst Khotgor coal reserve is proposed and awaiting approval.
- The Hydro power plant with 100 MW at Orkhon River will be built and connected to the central power system by installing a 220 KV electricity line.
- Build a thermo power plant with a capacity of 10-15 MW by using geothermal energy.

5.4.3. Construction and building materials

In 2010, the turnover in construction and installation works amounted to 350.8 billion MNT and the construction sector contributed 1.7% to the total GDP. Construction and installation works by domestic construction firms reached 93.1 percent of the total work or 326.5 billion MNT, whereas the share of foreign construction firms was 6.9 percent or 24.3 billion MNT (*Table 29*). At present, there are over 1500 entities in the construction sector employing 48.8 thousand people. About 81% or 1200 of these are located in Ulaanbaatar, Erdenet and Darkhan.

Table 29. Construction and capital repairs and maintenance, at current prices (billion MNT)

Type of construction unit		2006	2007	2008	2009	2010
Construction and capital repairs and maintenance total		266.8	389.4	508.2	279.4	350.8
Of which	Carried out by domestic construction entities	233.2	364.4	479.6	250.8	326.5
	Carried out by joint and foreign construction entities	33.6	25	28.6	28.8	24.3

Of all construction and installation works carried out by domestic construction firms 65.0% were in Ulaanbaatar, 12.7% in Western, 10.5% Khangai and 11.9% in other regions. The aimags with the most high construction and installation works are Gobi-Altai with 4.5% and Orkhon with 4.7% from total construction and installation works.

Some 204 companies and organizations are working in the construction material sector and most of them are located in Ulaanbaatar. Currently, domestic production increased and export of construction materials decreased.

In 2010, 322.5 thousand tons cement and 36.9 thousand m^3 concrete mortar was produced (Table 30).

Table 30. Output of construction materials

Commodity	unit	2007	2008	2009	2010	2010/2008, %
Sawn wood	*000' m^3*	11.0	17.4	14.5	20.2	116.1
Railway sleeper	*000' m^3*	16.7	16.7	14.3	12.5	74.9
Cement	*000' ton*	179.8	269.3	234.8	322.5	119.8
lime	*000' ton*	43.3	54.8	43.1	50.2	91.6
Concrete mortar	*000' m^3*	47.0	91.9	35.9	36.9	40.2
Metal sleeper	*000' pcs*	68.5	34.5	78.9	68.2	197.7
Bricks	*000' pcs*	20.8	28.9	18.0	27.7	95.8
Khurmen block	*million pcs*	287.6	601.3	418.8	647.7	107.7
Building wooden door and windows	*000' m^2*	2.8	6.2	2.5	13.8	222.6

The MDGs-based Comprehensive National Development Strategy includes the following aim: "Construction and development of urban settlements shall be accelerated with due account taken of proper patterns of population settlement. Production of construction materials will be brought to the level of countries with medium level of development".

There are several policy documents on the development of the construction sector. The construction and urban sector is developing based on the Regional development policy of Mongolia. Recently have been developed: a General Development Plan of Ulaanbaatar to 2020, a General Urbanization Plan of Development Regional Pillar Cities to 2020 and a Master Plan of Construction Materials Industry. In 1999, was adopted housing policy of Mongolia by State Great Khural and under consideration of the housing policy the GoM adopted and successfully implemented the "40000 housing program" since 2005. In 2008, the GoM adopted the "Ger Area Housing Development Program of Ulaanbaatar", and in 2010 adopted the "New construction and mid-term development program", which includes the "Housing for 100,000 Households" program.

5.4.4. Manufacturing industries

The large area and sparse population of Mongolia makes transportation costs relatively high and a significant element in production costs. Mongolia's land-locked location presents considerable barriers to foreign trade. Transport costs are high even by the standards of other Central Asian land-locked economies. Modernizing the rail network is difficult because the cost of upgrading so many tracks are high. These high transport costs in some way protect local producers against external competition in the small domestic market, but at the same time make it more difficult to export, particularly goods with low value-to-weight ratios.[23]

Manufacturing is an important sector for the country's economy because of the added value it produces. Until the 1990s, the manufacturing sector of Mongolia produced about 25% of the total GDP, but reduced since then and in 2010 the manufacturing contributed 8.5% to the total GDP at current prices, which was less than half of the overall manufacturing percentage of the major manufacturing countries.

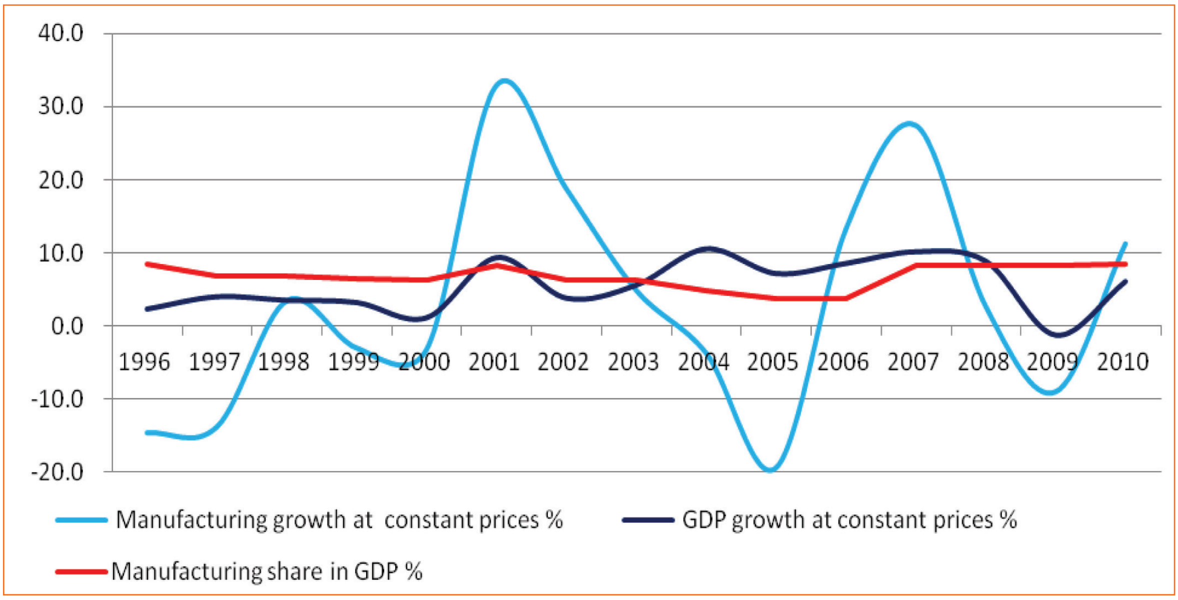

Figure 37. Growth and share of manufacturing

According to a survey of the United Nations Industrial Development Organization (UNIDO) 85% of the total export of Mongolia are raw materials that show a very low level of value-added production. The level of the production of final products is a basis of sustainable industrial development of the country.[24]

Table 31. Gross manufacturing outputs, at 2005 constant prices

Division	2006	2007	2008	2009	2010
Total of industry	1 555.9	1 773.6	1 823.4	1 763.3	1 938.8
Total of manufacturing	398.4	540.8	575.0	488.2	544.3
Food products and beverage	118.9	156.4	186.5	222.5	291.6
Manufacture of tobacco product	15.3	21.2	23.4	20.0	20.6
Manufacture of textile	111.8	124.4	130.0	116.2	91.5
Manufacture of wearing apparel, dressing and dyeing of fur	26.5	23.5	17.4	9.2	10.8
Tanning dressing of leather and footwear	8.2	4.7	2.1	3.0	1.3
Manufacture of wood and wooden products	2.4	3.5	4.3	3.4	4.6
Manufacture of paper and paper products	2.6	1.7	1.6	3.0	2.7

In 2010, manufacturing produced products were valued at 560.7 billion MNT at constant prices of 2005 (*Table 31*). Food and beverage products comprised 51.7% of the total production, 16.3% came from textile production and 22% from other manufacturing.

[23] Strategic Directions on Industrial Policy in Mongolia, UNIDO
[24] GoM. (2009). "Industrialization program of Mongolia"

Processing of livestock products

The report "Mongolia: Industrial and Trade Development Policy Review" (UNDP/UNIDO, 2002) defined the Mongolian manufacturing sector as "livestock-based". Products from livestock formed the basis for almost all the textile industry, and a significant portion of the food and garment industries. It includes meat and meat production, milk and dairy production, leather, wood and cashmere processing, garment and felt production etc.

Tanning, dressing of leather industry

Since the transition period, the manufacturing sector has been transformed. Before the transition the leather industry generated products at all levels of processing, however at present, mainly raw materials and only primary processed materials are exported to China. At the same time, the domestic demand for leather end products is imported from Korea, Turkey, China, etc. This is only one example of the downturn in the manufacturing sector. In 1992 the leather industry made up 8% of the total GDP and employed 15% of the labour force, but in 2001 it has reduced significantly and production and employment dropped below 1%.

To develop this sector, and to increase the export of end products, the GoM has adopted the "Hide and Leather" subprogram by resolution 114 of 2001.

Mongolia has a capacity to produce 7.0-8.0 million hide and skins per year, from which 52.4% is sheep skin, 26.2% goat skin, 7.1% cattle hide, 4.7% horse hide and 4.8% skin from other animals. Because of implementing the "Hide and Leather" subprogram, the production of the sector increased and reached 28.1 billion MNT at current prices, which was 0.6% of the total industrial output in 2010. At present, there are about 40 tanneries with a total capacity ofgprocessing 9.2 million of hide and skins per year and about 200 entities producing end productn. Only three of them are located in aimags and all the others in Ulaanbaatar. There werelin total:

- 35 tanneries primary processing,
- 5 tanneries deep processing,
- 4 fur entities,
- 8 footwear,
- 180 leather and garment,
- 4 dressing and dying of fur industries
- One research and preproduction center[25]

In 2010, the tanning, dressing of leather industry used 0.1 million m^3 water. The Regional Development program estimates the annual growth rate of the sector at 6.9% which means that in 2021 the water demand of the sector will reach 0.2 million m^3.

Tanneries, wool and cashmere industries used over 30 chemical substances for their processing which is likely to cause serious water pollution. Usually in Ulaanbaatar tanneries, wool and cashmere industries use water from the central system and discharge wastewater to the Khargia WWTP.

The Khargia WWTP was built in 1972 based on Russian technology and was expanded in 1985.It had a capacity 13000 m^3 per day for chemical and biological purification. Of late Khargia WWTP received only 7000-8000 m^3 wastewater per day, but because the poor technical and operation conditions of the pretreatment facilities it discharged untreated industrial wastewater directly to the central WWTP, causing pollution of the

[25] "Social economic development of Mongolia in 2009" NDIC, UNs population fund

Tuul River, the groundwater and the soil. In 2009 the ownership of the Khargia WWTP was transferred to Ulaanbaatar which makes it possible to rehabilitate it with state funding.

To reduce pollution from discharges of the tanneries, they were involved in an "Assessment of environmental impacts" that resulted in the use of environment friendly and more efficient technology. For example 'Mongol shevro" and "Darkhan Nekhii" LLC were involved in the "Clean industry" project and waste discharge reduced to 50%-20%. The action plan of the "New construction and mid-term development program" includes a detailed survey on polluting industries and the preparation of proposals to move these from Ulaanbaatar. The IWRM plan needs to address the implementation of water treatment, water reuse technology and stimulation mechanisms to use these.

Wool and wool production. Wool is an important export sector for Mongolia. Mongolia has the capacity to produce 32.4 thousand tons of wool and cashmere annually of which 68.2% is sheep wool, 20.5% cashmere and 11.3% camel wool.

Cashmere production is developing sustainably because of the continuing trend of the relatively high global cashmere demand. In 2010, there were generated 169.2 billion MNT of products at current prices or 3.6% of the industrial output (*Table 32*).

Table 32. Manufacturing wool and cashmere products

Commodities	unit	2006	2007	2008	2009	2010
Combed cashmere	*ton*	1 388.2	1 554.7	1 723.8	1 586.7	824.7
Scoured wool	*000' ton*	1.1	1.7	1.8	1.3	1.6
Spun thread	*t*	38.5	32.8	28.1	56.4	90.2
Carpet	*000' m^2*	606.3	658.1	856.5	542.2	609.6
Knitted goods	*000' pcs*	617.2	667.1	514.3	613.9	731.5
Camel woolen blanket	*000' m*	34.4	37.7	35	36.9	15.3
Felt	*000' m*	68.8	87.8	86.5	128.7	134.9
Felt boots	*000' pair*	7.8	9.3	6.3	13	27.9

In 2010, the production of combed cashmere and camel woolen blanket decreased to about half due to the winter dzud of 2009-10.

Currently, the export of raw wool increased to 8000 tons equivalent to USD 7.6 million, while the export of raw cashmere decreased by 13.2% from the previous year, but the revenues increased 14.4% to reach USD 104.9 million. The export of combed down cashmere decreased with 39.8%, but the revenues increased 0.7% reaching USD 68.8 million.

Since 2008, because of the world financial crisis, some small entities were closed and the number of workers decreased to 4.2 thousand persons in the wool and cashmere sector. At present, there are 54 factories in the cashmere and wool sector, of which 83% are primary processing factories and most of them (90%) are located in Ulaanbaatar.

In 2010 the wool and cashmere factories have used about 0.3 million m^3 water. The Regional Development Program of Mongolia projects the average growth rate of the industry at 6.9%. The water use will then be doubled by 2021 and reach 0.6 million m^3 per year.

Most wool and cashmere factories in Ulaanbaatar are discharging wastewater to the Khargia WWTPs or to the central sewerage system. According to the monitoring results of the GASI, in 2010 some wool and cashmere industries have used compact treatment facilities for cleaning industrial waste. Nevertheless, these facilities did not have technical permission.

5.4.5. Other Light Industries

Garment industry

The garment industry is an important sub-sector of the Mongolian industry. As of 2001, it constituted 35 percent of industrial GDP and employed 55 percent of the workforce of the industrial sector. Since the late 90s, the United States made some trade discount for the import of garments from Mongolia and became a major buyer. The export of textile products (mostly cashmere) increased from 54% to 75% between 1992 and 2001. The Government approved the "Program to develop garment production" in 2003 and this program is still being implemented. The objectives of the program are the following: to increase garment production, to keep export stable and supply the national needs from domestic production.

The export amounted to USD 17.9 million in 2008. In 2010 however, the export of textile products dropped to only USD 589.6 thousand dollars (<3%) mainly due to stopped trade discount. The workforce, which in 2007 comprised 4,700 people, scaled down to about 30% or 1,900 people. The domestic market has a big demand, but the supply has not increased due to poor finance and absence of raw materials and because the main garment industries, which are joint companies with foreign investment, stopped since 2008. The following textile products are supplied to the domestic market: uniforms and ger covers. The largest companies in this sector are "IKOS" LLC, "Oulen mench" LLC, "Anar Teks" LLC, "Suljee" and "Burte" company.

Manufacture of wood and wooden products

In 2010, the wood and wooden products sector generated 9149.3 million MNT at current prices or 3085.6 million MNT at constant prices of 2005, which was an increase with 35.6% from the previous year. The sector's share is 0.2% of the industrial sector production and 1% of manufacturing production. This sector produces and supplies doors, windows, floors, furniture, railway sleeper and frames for gers to the domestic market. Some 300 small and medium entities are working in the timber sector, from which 90 are located in Ulaanbaatar. About 3000 persons were employed in the sector. The import of wooden products decreased for the past years and it was 20 million dollars in 2008 and 17.7 million dollars in 2010. There is some possibility to expand domestic production. In 2009, industrialization received much support and some 2307.0 million MNT was invested in this sector. Some industries were built in Ulaanbaatar city and other local areas. These industries supplied 100 people with jobs. The Government of Mongolia is implementing the "The program to recover the production of the wood industries and tackle the social problems and employment of village people", which has approved in 2000.

Paper products and printing industry

This sector covers some 220 registered entities, 90% of which are located in Ulaanbaatar and 10% in the rural areas. The sector employed some 4000 thousand people. Of these entities 20% are fully equipped big industries[1]. Textbooks take up about 30% of the printing industry products, newspapers and magazines 20%, advertising 15%, tags and packaging 10%. The printing, publishing and recording activities generated 9.1 billion MNT at current prices. The production of paper products and printing industry had a value of 16 billion MNT at current prices. The Government of Mongolia approved a "Program of Printing industry" by the order number 53 in 2008. The objectives of the program are:

- to work with investors and do research on how to establish paper industry based on domestic raw materials;

- to support the production of printing ink and substances;
- and to receive technical aid in order to establish the industry that produces nature-friendly packages and establish small size industries in the regional centers which produce printing techniques and spare parts.

Other industries

The cigarette industry is booming in Mongolia; it generated 36.5 billion MNT worth of products at current prices in 2010 or 20.6 billion MNT at 2005 constant prices. This was an increase of 2.9% over the previous year. The sector's share is 4.2% of the processing production.

The industries of chemical substances, liquid fuel, rubber and plastic produced 60.8 billion MNT worth of products in 2010 and their share is 3.2% of the processing industrial sector.

These sectors of light industries used 0.1 million cubic meter of water in 2010. According to the objectives of the regional development programs, this sector's production would increase by an average 6.9% per year. By 2021 the sector's water demand would reach 0.2 million cubic meters. In addition, the water demand of the planned garbage processing industry would be in the order of 0.8 million cubic meters per year.

5.4.6. Food Industry

Food security is considered vital by every country. Also the Government of Mongolia gives high priority to this issue. The Government has subscribed to the Rome's" Declaration of World Food". In 1994, the Government of Mongolia approved the national program "Improvement of population food supply, the food of Mongolian people", but due to the economic crisis and natural disasters this program was not yet been fully implemented.

In 2001 the Government of Mongolia approved a national program "Food supply, security and foods". The program states the following: "The population food supply and food security is very important for the stable society, economy, politics and independence. And it is a basic trend of state policy." In 2009, the Government of Mongolia issued several policy documents. They include "State policy on food and agriculture", "Millennium Development Goals-based Comprehensive National Development Strategy" and "Recommendations of World Food Conference". The Government also approved a national program "Food security" that is being implemented.

Mongolia had harvested some 355.1 thousand tons of grain in 2010 and produced 204.4 thousand tons of meat and 338.4 thousand tons of milk. Products produced by the food industrial sector are:

- meat processing 12 thousand tons
- sausages and meat products 1.9 thousand tons
- milk and dairy products 23.5 million liters
- flour 143.4 thousand tons
- bread 21.7 thousand tons

The total production in 2010 is valued at 504.4 billion MNT at current prices (291.6 billion MNT at 2005 constant prices). The sector's production increased by 31% compared to the previous year.

Table 33. Output of food and beverage sector, in billion MNT, at constant prices of 2005

Commodities	2006	2007	2008	2009	2010
Manufacture meat, fish, fruits, vegetables and fat	12.3	11.6	20.1	26.7	21.7
Milk, dairy products	3.8	5.6	8.0	11.1	16.8
Flour	25.3	28.0	24.9	40.6	56.9
Alcohol, beer and soft drinks	54.4	85.2	103.3	118.8	159.1
Other food products	23.2	25.7	30.2	30.7	28.1
Total	118.9	156.0	186.6	222.5	291.6

The food industry's share is 10.7% of total industrial sector. Meat, milk, yoghurt, bread, sweets, alcohol, beverage, beer, and wine are produced by domestic industries and supply the domestic needs. The domestic needs for rice, sugar and vegetable oil are met fully by imports.

Meat processing production

The meat processing production supplies 100% of the domestic needs and exports its surplus production. Mongolia slaughtered 8373.7 thousand livestock and prepared 204.4 thousand tons of meat. The meat processing production generated 21.7 billion MNT at 2005 constant prices *(Table 34)*. Less than 10% of the meat enters the industrial processing. In 2008 the "Physiologic norm of population foods" was approved by the order of the Minister of Health. An average person[2] should consume 150-200 grams of meat a day or 68.5 kg of meat and meat products per year. In 2010 the consumption reached the average of 74.1 kg of meat per person.

Mongolia has 32 registered slaughterhouses and their production capacity is 85 thousand tons of meat per year. Only 18 of these are actually operating employing about 13 thousand persons. It is claimed that the meat-processing industry utilizes only 14% of its total capacity. The following industries have more than 100 employees and their production capacity is high:

- Ulaanbaatar's "Makh Impex" LLC,
- Meat processing industry of Bagakhangai,
- "Khanburged" LLC of Bayan-Ulgii aimag,
- "Dorniin Govi" LLC of Dornogobi aimag and
- "Tesiin Gol" LLC of Zavkhan aimag.

The sector exports: beef, horse meat, mutton, canned meat products, pet foods and processed guts of the livestock.

Table 34. Meat, meat production, export and water use of meat sector

Commodities		2006	2007	2008	2009	2010	2010/2009
Meat	Total, thous. ton	170.7	191.2	221.3	269.1	204.4	-24.0%
	Manufactured, thous. ton	7.8	6.8	12.0	18.3	12	-34.4%
	% share of the manufacturing	4.5	3.6	5.4	6.8	5.9	-
Sausages and canned meat, 000' ton		1.6	1.6	2.3	2.0	1.9	-5.0%
Small intestine, 000' roll		700.4	644.3	641.1	1057.1	1288.5	21.9%
Exported meat, 000' ton		11.7	11.0	10.3	18	26.8	48.9%
Exported small intestine, ton		260.1	290.7	438.5	380.8	644.9	69.4%
Total production, at current prices, million MNT		10310.3	16304.7	31365.5	42563.5	32569.7	-23.5%

Mongolia has a large meat resource but meat processing technology and equipment do not meet world standards making it difficult to increase the export. There is a serious shortage of freezer-trucks to export meat products severely reducing the meat quality, which leaves only the two neighboring countries as export markets.

This sector used 340 thousand cubic meter water in 2010. The production is estimated to increase by 6.9% per year on average. Consequently water demand is estimated to reach 474.6 thousand m^3 in 2015 and 708.3 thousand m^3 in 2021.

Production of dairy products

Some 338.4 thousand tons of milk was produced in the agricultural sector in 2010. About 5.2% or 17.5 thousand liters was processed in dairy plants. In addition, 6 thousand tons of yoghurt, 731.7 tons of butter, 114.8 tons of cheese and curds and 26.5 million pieces of ice cream were produced.

The Government of Mongolia approved the "Milk" national program in 2006 and its implementation started in 2007. The main objective of the program is to increase the dairy product methods and to increase the quality, the hygiene and the supply of the domestic needs. According to the "Physiologic norm of population foods", an average person[3] is required to consume 140.8 kg of milk and dairy products annually. In 2010 it reached 122.2 kg of milk per person as a national average. This indicator shows a decrease compared to the previous year. Moreover the milk consumption differs per location. In Ulaanbaatar, the consumption was 66 kg of milk per person and in the countryside[4]244.8 kg.

Only about 5% of all the milk is processed in the dairy industry. Mongolia has a huge resource of milk but still imports dairy products. It means that there is a high potential for developing a dairy industry. There are 90 industries with the capacity of processing 220 thousand tons of milk a day nationwide. Only 20 of these are actually operating and utilize about 40% of the total capacity. The largest is Milk LLC, which has 350 employees. Ulaanbaatar, Darkhan-Uul aimag and Orkhon aimag are the leading milk producers in the country.

In 2010, dairy products amounting to 30.6 billion MNT at current prices were produced. (Table 35)

Table 35. Milk, dairy production

Commodities		2006	2007	2008	2009	2010	2010/2009,
Milk	Total produced, million l	450.1	465.6	457.4	493.7	338.4	-31.5%
	Manufactured, million l	4.1	5.5	7.4	10.4	17.5	68.3%
	Share of the manufacturing, %	0.9	1.2	1.6	2.1	5.2	145.5%
Yogurt, million l		1.5	2.8	4.7	4.1	6	46.3%
Cream and butter, ton		57.6	85.1	379.5	812	731.7	-9.9%
Cheese and curds, ton		46.9	53.5	103.2	143.2	114.8	-19.8%
Ice-cream, 000' pcs		6639.2	10081.2	8955.6	16638.7	26450.1	59.0%
Total production, at current prices, million MNT		2.9	6.4	14.9	21.4	30.6	43.3%

A project by the name "Increase big cities' milk production and supply by decreasing losses in the milk production" is being implemented to develop milk production. In the second phase of the project, milk production equipment is given to people and entities on condition of paying back. In 2009, some 50 entities and people were given i.a. complex equipment for sanitation, cooling and packaging; milk cooling tank; industrial equipment to process 500-1000 liters of milk a day. These donations had a good impact.

This sector used 148,200 m^3 water in 2010. It is estimated that production will increase by an average of 6.9% per year and water demand would then reach 474,600 m^3 in 2015 and 708,300 m^3 in 2021.

Production of pastry

Pastry is important for Mongolian's diet. According to the "Physiologic norm of population foods", an average person would need 116.8 kg of flour and pastry per year. Mongolia's annual demand would thus be 240.0 thousand tons on average. The "Wilderness-3 campaign" was implemented between 2008 and 2010 with the result that Mongolia could supply 100% of the domestic needs.

Table 36. Flour and bakery product, in tons

Commodities	2006	2007	2008	2009	2010	2010/2009
High grade	18 234.3	22 392.5	18 931.7	21 732.5	33 476.3	54.0%
1st grade	36 298.7	36 119.3	34 715.9	72 713.5	97 647.6	34.3%
2nd grade	7 122.1	12 284.2	8 366.7	10 865.6	12 364.8	13.8%
Manna-croup	858.7	786.7	640.8	829.6	1 476.9	78.0%
Bread	20 385.4	20 442.5	25 798.1	23 519.4	21 747.5	-7.5%
Bakery products	10 161.0	12 974.0	13 158.5	12 763.8	12 926.9	1.3%
Cake	152.7	295.4	482.1	405.6	387.8	-4.4%
Biscuit	436.7	406.5	496.1	285.2	347.8	21.9%
Macaroni, noodles	1 006.4	1 361.4	2 309.8	4 495.0	2 084.8	-53.6%
Total production, at current prices, million MNT	23.1	36.2	55.7	73.4	85.7	16.8%

In 2010, 143.5 thousand tons of flour and 39.5 thousand tons of pastry were produced. (*Table 36*). Although the production of flour and pastry increased, the noodle production decreased.

For the past years, domestic flour production increased and import decreased. The reason is that the Government of Mongolia paid much attention to the food security.

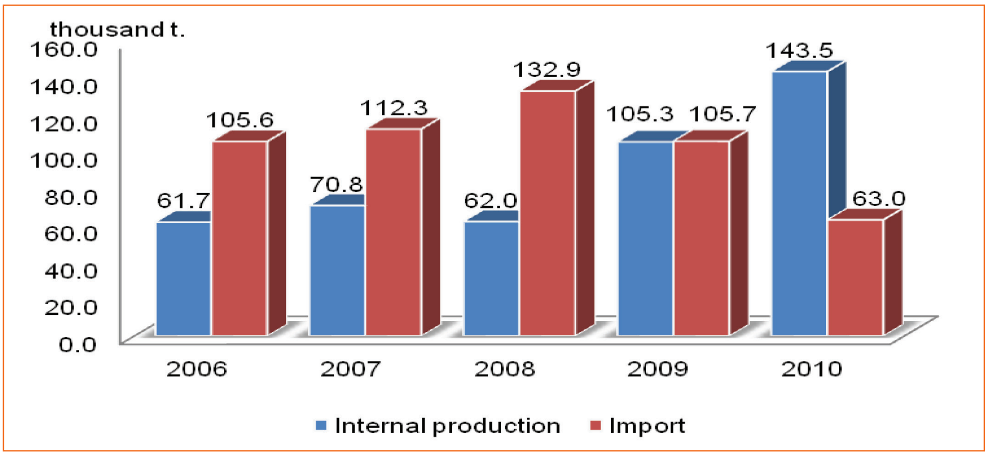

Figure 38. Flour production and Import

There are some 70 industries with the capacity of producing 380 thousand tons of flour. Each aimag has a pastry industry and 22 elevators are operating with the capacity of separating 338 thousand tons of grain. Some equipment was installed with Asian Development Bank financing. With this equipment, 28 industries are producing enriched flour. The major pastry industries are:

- "Altan Taria" company,
- "Ulaanbaatar Flour" LLC,
- "Dornod Flour" LLC,

- "Atar Urguu",
- "Uguuj Chikher Boov"
- "Talkh Chikher" LLC.

This sector used 786.1 thousand m^3 water in 2010. The production is expected to increase by 6.9% per year on average and water demand would reach 1,097.4 thousand m^3 in 2015 and 1,637.6 thousand m^3 in 2021.

The production of alcohol, beer and beverage comprises 40% of foodstuff production. The water is the key raw material for the production of beverages. In 2010, 1,825.6 thousand cubic meter water was used by this sector and products valued at MNT 239.8 billion were produced. It includes 135.9 thousand tons of juice, and 44.9 thousand tons of beer (*Table 37*).

Table 37. Soft drinks, alcohol and beer, in tons

Commodities	2006	2007	2008	2009	2010	2010/2009
Spirit	4 032.9	5 721.5	6 778.9	3 541.4	3 609.1	1.9%
Alcohol	10 495.8	12 263.8	15 297.2	17 302.2	20 249.8	17.0%
Vine	223.8	327.5	196.6	108.7	146.9	35.1%
Beer	7 393.0	18 377.7	19 891.1	32 445.1	44 878.5	38.3%
Water	10 075.0	14 533.6	17 506.4	17 058.2	24 405.0	43.1%
Soft drinks	24 311.7	45 771.3	45 740.2	43 353.5	67 904.4	56.6%
Juice	4 426.5	9 427.2	22 852.4	26 556.2	43 062.6	62.2%
Total production, at current prices, million MNT	51.6	85.7	128.1	160.6	239.8	49.3%

The number of alcohol industries decreased with 60% since 2004. But the volumes produced is still increasing. The vodka and wine comprises 34% of the alcohol production, beer 50% and spirits 15%. The domestic production supplies 98.8-100% of alcohol, 17.1% of wine, 55.9% of beer and 90.5% of non-alcoholic drinks. Many measures were implemented in the fermentation industry, including the introduction of new technology, improvement of internal structures for monitoring product quality and hygiene, supporting the production of safe products and improving product quality.

In most aimags beverage industries are operating and there are 15 spirit, 93 alcohol, 21 beer industries and 14 wine industries. There are some 67 alcohol industries in aimags and 41 alcohol industries in Ulaanbaatar city. The major industries with more than 100 employees are:

- "Spirit Bal Buram" company of Selenge,
- "APU" company, "Mon-Erdene" LLC,
- "UFC" LLC, and
- "MCS Coca Cola" LLC.

The production is estimated to increase by 6.9% per year on average and the water demand would reach 2548.5 thousand m^3 in 2015 and 3803.2 thousand m^3 in 2021.

The development trend of food sector

The Mongolian policy on food sector focuses on increasing product quality, production and food security in the framework of regional development. The Government of Mongolia has formulated the following goals:

- to improve population food supply;
- to ensure the sector's stable development;

- to increase production;
- to establish export complexes which meet the international standard;
- to increase industrial capacity and to supply with necessary technology in order to supply urban population with meat and milk processed by industrial methods;
- to establish milk cooling centers among the farmers;
- to establish meat processing industries;
- to introduce technologies for producing enriched products;
- to establish baby milk industry;
- to establish processing industries which have technologies to keep vegetables and fruits safe without losing quality;
- to support the production of ecological products;
- to increase export by introducing monitoring structures for food security and production.

The "Crop Rehabilitation-III-National" program had a good impact on food and agricultural sector development. Under this program the following projects are being implemented:

- "Green Revolution",
- "Milk",
- "Fresh Ecological Products",
- "Livestock Health",
- "Support for Animal Husbandry Development",
- "Improvement for Livestock Quality"
- "Mongol Livestock".

The GoM developed a "Food Security" program based on UN's and international organizations' decisions, standards, guidelines and recommendations and Government policy objectives.

According to the program, in 2012 -as compared to 2007 - the production of the food industry is expected to increase by 30% and meat production by 35%.

The expected outputs of the Food security program are:

Output	2012	2016
Processed meat production	50,000 ton	60% of urban population meat demand
Meat export	20,000 ton	38,000 ton
Processed milk production	-	Increase 2 times from 2008
Eggs	-	Increase 100%
Butter	-	Increase 20%
Fish	-	Increase 15%
Fruits	-	Increase 15%
Rice	-	Increase 5%
vegetable oil	-	Increase 40%

Some 781 million dollars is required to implement this program in 8 years' period. As for the economic breakdown, 39.5% will be financed by the Government and aimags' budget, 45.7 percent by private entities and 14.8 percent by foreign aid and loans.

The water supply is very important to implement the above mentioned objectives and programs. This sector's water demand would increase 2-3.5 times by 2021. It is important to pay attention to aimag, soum centers and new towns and villages emerging following mining development.

Small and Medium Enterprises

By 2010, there were 73,000 registered entities in Mongolia, and some 40,900 of these are operating. 97% or 39.7 thousand employ less than 50 persons. 87.7% or 34.8 thousand entities employ between 1 to 9 persons. It means that micro business comprises most of these businesses. In Ulaanbaatar city there are 26.9 thousand entities or 65.8% of the total. In the countryside there are 14 thousand entities or 34.2%. The small and medium industries are mainly located in urban areas and 71% is in Ulaanbaatar, Darkhan and Erdenet. As for the aimags, Selenge aimag has the most small and medium industries and some 1.5 thousand industries are operating there.

80% of the sector involves is comprised of services and sales. The Government of Mongolia has taken some measures on small and medium industry development. The "Support Program for Small and Medium Industry" was approved by the Government of Mongolia by order number 64. The small and medium industries of Mongolia are developing on the basis of household production such as sales, animal husbandry, raw material supply and spare parts' supply to big industries.

5.4.7. Future Trend of Industrial Development

In the "Millennium Development Goals-based National Comprehensive Development Strategy" the Government of Mongolia defined the following as the leading trends for national development: economic development based on high technology, communication, nano technology, transit transportation, logistic networks, mining, and industries for agricultural products. The Government approved the "Industrialization Program for Mongolia" according to resolution 299 in 2009. The main objectives of the program are to

develop industrialization based on domestic resources and possibilities, and to increase competing capacity of the country by creating strong economy. In the objectives of the program it was defined: "Increasing production of final products by scaling up the raw material processing level and develop industries in complexes" Besides that the program also includes support centers for small and medium industries in each aimag, expanding these centers' activities and securing population food supply by building cellars and greenhouses, building fodder industries based on regional features, and expanding raw material production of animal husbandry.

The Ministry of Food, Agriculture, and Light Industry carried out studies to define directions of industrial development and the following industries were found necessary:

- processing industry of livestock raw materials;
- grain and flour industry;
- vegetable processing industry;
- vegetable oil industry;
- cement industry;
- processing industries of metal and concrete materials;
- bio and nano technology industry;
- and bio fuel industry.

In June of 2009, the Government of Mongolia approved a project called "Development trends of industries in rural areas" by the resolution number 178. By implementing this project, some 900 industries and entities will be set up in rural areas and 9,900 jobs will be created. Within the framework of above mentioned directions the following measures are planned:

- best quality livestock farms will be established in 16 aimags;
- build meat industries in 3 aimags;
- build 1-2 milk industries in each aimag which has the capacity of processing 200-1000 liters of milk a day;
- build cooling centers with the capacity of 500-2500 liters a day in 8 aimags and
- establish dairy-husbandry fodder and greenhouse farms.
- processing and packaging of vegetables;
- developing bee husbandry;
- expanding bird husbandry;
- establishment of timber-works, metal industry, packaging industry, and electronics industry.

As a result the GDP of processing industry will increase. The new small and medium industries are listed in Annex 23.

5.5. Service sector

The service sector is one of the dominating economic sectors and in 2010 this accounted for 2,828.1 billion MNT of GDP or 46.7% of the total national GDP. It supplies 54.9% of Mongolia's labor force with employment. The sales and transportation are the driving forces of the sector's performance.

5.5.1. Public urban service[26]

Since 1930, special attention started pay to the public urban sector related to the establishment of the cities and urban centers in Mongolia. From 1950, urban development programs were implemented and the Soviet Union supported intensive construction programs for apartments and other buildings.

Urban water supply and sanitation

The urban services first focused on developing centralized water supply and sewerage facilities. Such facilities are important to provide a pleasant living and working environment for people, provide proper operation conditions for industries and services, and for protecting the environment and people's health.

Public urban service organizations

The Ulaanbaatar's Water and Sanitation Company (USUG) and Housing and Communal Services Authorities (OSNAAG) are responsible for the WSS services in Ulaanbaatar. In the other aimag centers and cities Provincial Public Urban Services Organizations (PUSO) are operating. (see *Figure 39*).

[26] The chapter has used mainly Report by Mr. Tsedendamba, Policy Analyst Roads, Transport, Construction & Urban Development

68 public service entities:
- 1 state property company
- 21 local property companies and entities
- 15 private companies in Ulaanbaatar
- 31 local property companies in aimags

The Operational costs of the sector in 2010 amounted to 71.9 billion MNT while revenues reached only 70.3 billion MNT, which means an operational loss of 1.7 billion MNT. Nevertheless this loss was 43% less than that of the previous year.

According to the financial audits, the local property companies in Ulaanbaatar accrued a total loss of 1.9 billion MNT, while at the same time the private companies booked a 77.0 million MNT profit.

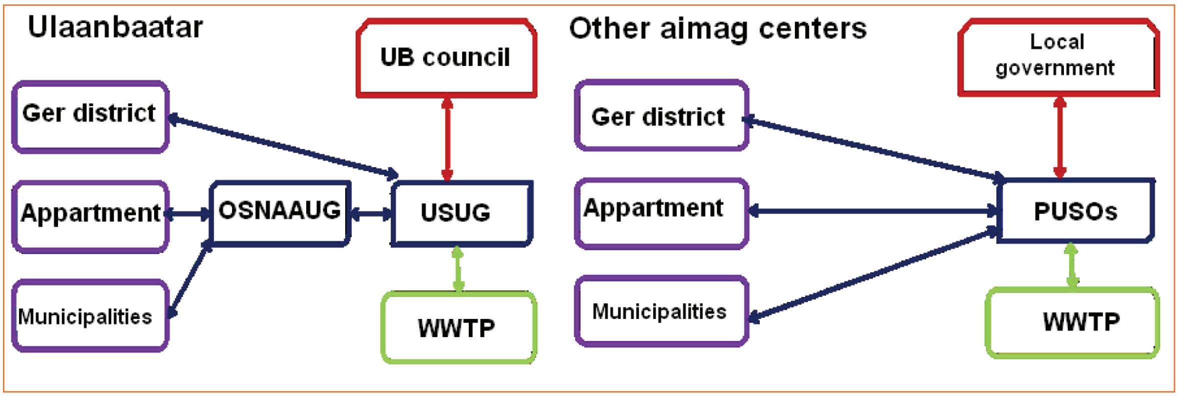

Figure 39. Drinking water supply structure

At present in Ulaanbaatar, the western and the central regions 13 aimags have successfully implemented urban service development projects funded by the World Bank, the Spanish Government and an ADB soft loan (the "Urban development Sector" project). However, due to the low level of cost recovery the interest-bearing liabilities have accumulated. As the returns are low and the sector lacking sufficient own capital the old pipelines and networks cannot be rehabilitated, the reliability of the operations cannot be ensured. The entities are quite passive and only look for government or foreign support.

International experiences to correction such a situation is to improve legislation and tariff conditions while implement cost sharing and Public Private Partnerships (PPP). In 1990 Mongolia has initiated a privatization program in the public utility service sector. Following the "Concept of State Property Privatization" adopted by 48^{th} resolution of GoM in 2005, the action plan "Concept of Privatization and Modifying Public Utilization and Service" was approved by 80/200 decree of Chairman of SPC and Ministry of RTCUD in 2009.

Water and wastewater demand

In the urban areas domestic water is generally supplied from wells through central networks, kiosks. In the rural areas from surface water and snow. The daily water consumption of people living in apartments in the cities is between 200-350 liters per person. While the daily water consumption of ger area residents as well as rural herders is only 5-10 liters per person on average, which is less than half (in extreme cases less than 25%) of the WHO's recommended minimum.

Table 38. Drinking water coverage

Water sources		2005*		2008		2010	
		Population		Population**		Population**	
		thous. person	%	thous. person	%	thous. person	%
Central WS system	apartment	563.9	22.0	551.7	20.7	602.1	21.7
	kiosks	217.6	8.5	324.2	12.0	410.4	14.5
Transportation (kiosks), boreholes		668.7	26.1	612.8	23.0	593.3	22.8
Protected wells, springs (soum centers and rural)		222.8	8.7	297.1	11.0	361.5	12.9
Unprotected wells, springs and other sources (soum centers and rural)		889.3	34.7	859.6	33.3	780.1	28.2
Total		2562.3	100.0	2645.4	100.0	2747.5	100.0

*Source: * MRTCUD **NSO, population by location*

In 2010 some 21.9% of total population lives in the apartment, which connected to the centralized water supply and sewerage system (*Table 38*).

A number of recent surveys on water connections yielded some varying results:

- the MDGs (2006) states: 39.2% of the population uses protected sources
- an ADB survey (2008) states 76.0% of the population uses improved water sources
- IWRM project (2010 using statistical information) arrives at 71.6% of the population using improved water sources

In 1997 water metering in 56 Heat and Water Distribution Centers in Ulaanbaatar was tested concluding that residents in an apartment buildings used 430-450 l/day per person. As a result of containing water losses and installing water meters the present consumption is reduced to 230.8 l/ day per person. About 10 years ago USUG records show only 14.5% of the total consumers had their water metered; the ratio between pumped and sold water was 50.6%t and only 49.1% of the pumped water was actually billed. Today USUG meters 99.9% of the consumers including 100% of the industries and entities and the billing of metered water is 100%. Surveys in Darkhan and Choibalsan have shown similar results. However, only 25% of the customers in Ulaanbaatar are individually metered. They consume only 87 liter per capita per day.[27] This means that individual metering is likely further decrease water consumption. There do not appear to be any projects in place to stimulate this.

Table 39. Pumped & delivered water and treated waste water

Type of water		2006	2007	2008	2009	2010	2010/2009
Total of Mongolia	Delivered water million.m^3	60.1	64.7	65.4	63.3	61.7	97.5%
Ulaanbaatar	Pumped water million.m^3	55.4	56.3	55.1	52.9	52.1	98.5%
	Delivered water million.m^3	40.4	41.9	43.2	43.8	43.1	98.4%
	Unaccountable for water %	27.08	25.58	21.60	17.16	17.22	100.3%
	Treated waste water by WWTP, million.m^3	55.9	55.2	54.9	53.7	54.0	100.6%
	Waste water million.m^3	39.1	41.0	42.6	41.3	42.1	101.9%
	Unaccounted wastewater %	30.05	25.72	22.40	23.12	22.08	95.5%

[27] Worldbank – PPIAF, Rethinking the delivery of infrastructure services in Mongolia, 2007

Table 39 shows water delivered by PUSOs and USUGs and treated wastewater. The difference between pumped and delivered water is indicating the unaccountable water. Since 2006, the country's supply of domestic and municipal water by PUSOs and USUG has increased with 1.7 million m^3 although since 2008 the figures show a decreasing trend again.

As a result of implementing Public service improvement projects and reducing leakages the unaccounted for water and wastewater has recently decreased in Ulaanbaatar.

Table 40. Water use and wastewater treatment of Ulaanbaatar

Type of consumers			2006	2007	2008	2009	2010	2010/2009
Water	Popu lation	Centralized system	31.3	31.5	32.2	32.4	31.9	98.7%
		Kiosks		1.0	1.1	1.2	1.3	110.6%
		By transport		0.01	0.01	0.05	0.01	28.3%
	Municipalities and entities		9.1	9.2	9.9	10.2	9.8	96.1%
	Total		40.4	41.8	43.2	43.8	43.1	98.4%
Waste water	Population		29.1	31.1	30.9	30.7	31.5	102.6%
	Municipalities and entities		10.4	11.0	12.0	10.6	10.6	100.0%
	Total		39.4	42.1	42.9	41.3	42.1	101.9%

About 70% of the total delivered drinking water of Mongolia is Ulaanbaatar's water use. Some 77.3% of Ulaanbaatar's water use was for the population and some 22.7% was for public utilities, services and entities.

In 2010 USUG raised the water tariff for apartment households with about 35% (incl. VAT) and subsequently the water consumption per person decreased from 261 l/day to 230.8 l/day. The price elasticity for (drinking) water demand was -0.33, which indicates a low price sensitivity.

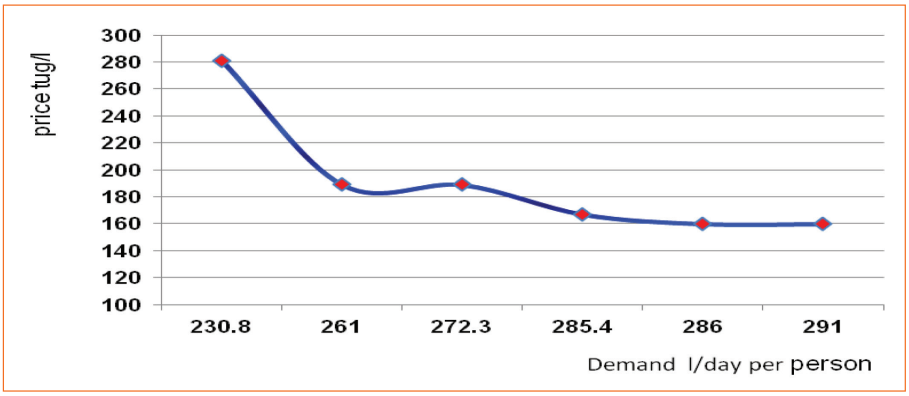

Figure 40. Relation between drinking water demand and water price for apartment households

Recently the number of apartment households in Ulaanbaatar is rapidly increasing, but the total water use has not changed as much, probably due to the installation of water meters and the tariff increases. Most population of city live in the ger areas where water use is very low as water has to be collected from far and stored. Households also pay much more for water at the kiosks.

Future trend of water supply and sanitation

The 5.th priority strategic goal of the "MDGs based Comprehensive National Development Strategy" is the basis for the development of the "Water" National Program. This program creates the conditions for the protection of water resources from pollution and deterioration, for proper use of water and to supply the population with water that meets health and hygiene requirements. The "Water" National Program has meanwhile been approved.

This policy document is the main document indicating the development trend of water supply. Implementation will be synchronized with the master plan of the city and settlement area. The major investment and construction focuses on the development of the water supply and sewerage system.

Under the "Water" National Program 50 major complex measures will be implemented, involving a 2 trillion MNT investment.

Following the approved Master Plan of Ulaanbaatar and "Housing for 100,000 Households" about 75,000 to 80,000 apartments will be constructed in Ulaanbaatar, and another 25,000 apartments in the regional pillar cities and aimag centers. To increase the share of apartment households to over 80% by 2020[28]the "Ger Area Housing Development Program of Ulaanbaatar" aims to develop the ger areas into apartment microregions, This program covers 22 ger areas in six districts in Ulaanbaatar[29]

In 2011 the action plan "Program for great construction and mid-term goals" (which includes the "Housing 100000 Household program) was approved by CSGM, MRCUD and MNET. It aims to support rural development and to do so will implement a "Mid soum center" model project. This project will be implemented in some soum centers and improve or construct infrastructure including water and sanitation there. The action plan will require about 2736.8 billion MNT for the WSS sector investment.

A number of projects will be implemented under loans from international banks, financial organizations and bilateral assistance from donor countries. It is noted that investments increase under aid funding. However it should be realized that with the considerable growth of the Mongolian economy that is predicted, foreign aid, especially grants will rapidly reduce.

All these measures prepared the conditions to reach the Millennium Development Goals of Mongolia that aim to reduce the percentage of population lacking reliable water supply to 40% and reduce the percentage of population not receiving improved sanitation services to 60% by 2015. By 2020 70% of the population in city and settlement areas would be connected to the central water supply system and 70% of the water supply and sewerage engineered facilities would have been extended and renovated. Also by 2020, the water supply for more than 20 soums will be improved by installing water-softening equipment

Moreover, some objectives of the "New construction and mid-term development program" and "Water National Program" will be attained by introducing small-scale water supply and sewerage networks and new technology in resorts and sanatoriums, tourist camps, hospitals, schools and kinder gardens including private investment and supporting activities to construct improved pit latrines and dry toilets in a ger area etc.

The drinking water use of Mongolia was 57.6 mnl m^3 in 2010 and when the targets of the forementioned programs and projects are achieved water use will increase by 50% in 2015 and about 70% in 2021.

Futhermore in planning the following needs to be considered:

- to allow for the implementation of existing policies and programs depending on water availability, water infrastructure capacity and future water demand.
- to include concepts like "Green Town", "Eco Town" and "Compact Town" as

[28] Master plan Ulaanbaatar

[29] Mr. Tsedendamba, Report of State Policy, Project implementation, Future Trend in the Road, Transport and Urban Development Sector Water Supply, 2010

applied in highly developed countries for the proposed new cities, towns and micro-regions.

- to solved the drinking water issues by consumer type, like apartment, ger area, urban and rural and herders' households;
- to achieve ecological sustainability;
- to advance water efficiency use.

In the planning measures related to increased water use in the ger area and rural households needs support. Proposals for improvement of water pricing and cost recovery and possible approaches to reduce the financial losses by the water supply organizations based need to be included in the plan. Lessons may be learned from international experiences on such issues.

5.5.2. Transport

Statistical information over 2010 indicates that the transport sector processed about 29.4 million tons of freight and 250.7 million passengers through various kinds of transport means. The freight turnover reached 12,124.8 million.t.km. and passenger turnover 3372.4 million.pass.km. This generated a total revenue of 604.9 billion MNT.

The total transported volume grew by 4.7 million.t freight or 18.9% and 18.2 million passengers or 7.8% between 2009 and 2010.

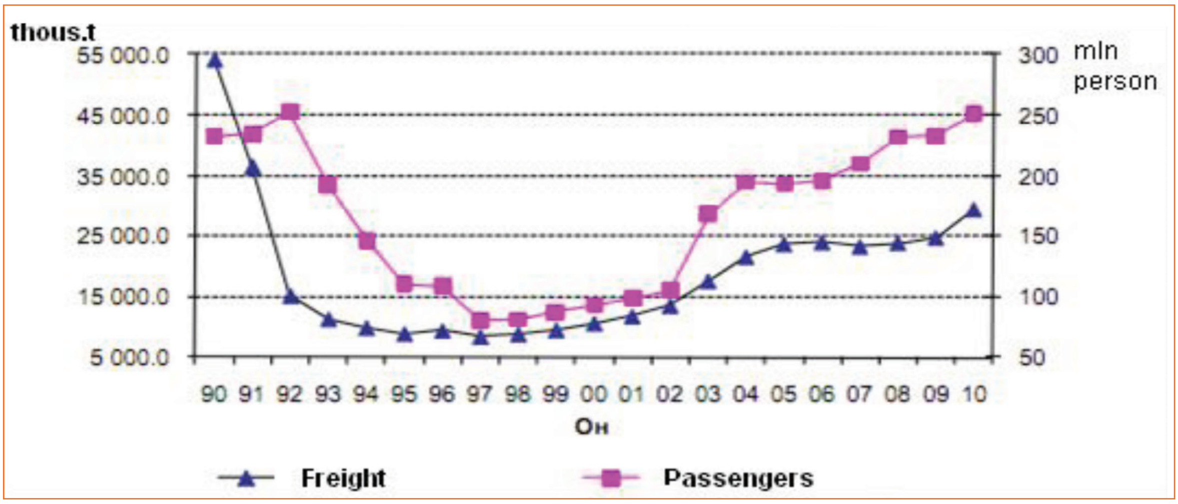

Figure 41. Overall passengers and freight of all type of transportation

5.5.3. Sales and services

Trade

The main trade organizations were established 90 years ago. The GoM is implementing a policy to develop foreign and domestic sales with mutual benefits based on the common principle of free trade.

The wholesale and retail business generated 15 percent of the country's total GDP. Some 14.7 thousand entities are operating employing 146.2 thousand people. The total production is estimated at 1185.4 billion MNT. The share of the wholesale business is 57.8% and retail business 42.2% of the sector total GDP. The sector's GDP is almost completely produced by the private sector. On average, there are some 54 costumers at one shopping center. In Ulaanbaatar, it is the minimum and it is 37. The highest is in Khuvsgul aimag and it is 166.

The processing of agricultural raw materials is not well developed in Mongolia. Because of the retailers, prices of the agriculture raw materials are often fluctuate. Sometimes it effects on the living standard of the herders. In 2001, the Government started implementation of the program "Wholesale business networks". The objectives of this program are to develop the system of raw material preparation, transportation, conservation, trade and processing. The Government lent 3.1 billion MNT to 55 entities and companies in 18 aimags. The result is that these companies' shopping centers are now operating in 100 soums in these 18 aimags.

The Government is paying much attention to this issue and enacted its 2008-2012 implementation measure program by establishing market networks based on information technology that enables rural people to sell their raw materials and products straight to the consumers.

Mongolia trades with 114 foreign countries and foreign trade turnover was 6108.6 million USD in 2010. The trade sector policy aimed:

- To increase the export of end products,
- To establish a decent trade condition,
- To reduce import dependence,
- To support the trade balance,
- To increase employment in the sales sector.

Hotels and restaurant services

Tourism is increasing in Mongolia. Hotel and restaurant services are developing rapidly as a result. This sector generates 0.8% of country's GDP. For 2010, the turnover was estimated at 133.5 billion MNT about equally shared by the hotel and the restaurant business

> 84.8% of the total export goes to China and 4.9 % to Canada. Imports from Russia amount to 32.7%, from China 30.3% and 6.1% from Japan.

Some 1320 entities of which 817 in Ulaanbaatar are operating in the sector that employs about 9,700 persons. The hotels and restaurants in Ulaanbaatar and aimag centers are supplied their water from the centralized water systems. In soum centers, they are supplied from protected kiosks.

Other services

Some 200 entities are operating in this sector and 1,200 persons are employed there. However, according to a survey conducted in 2007 some 60 thousand people were working in the service sector. The discrepancy may be explained by the fact that 98% of the services are in the informal. The Government developed a "Support program for the public service sector" that is being implementation since 2008. The objectives of the program are improved service quality, capacity and availability, to increase economic benefits and to increase consumers' satisfaction. The main goals are:

- to increase the role of the utility sector in the implementation of Millennium Development goals;
- to create economic environment, which supports utility sector development;
- to support human development and increase service availability by strengthening government and non-government organizations' partnerships.

Most of the public service organizations are connected to the central water supply and sewerage networks.

This service sector used 3337.5 thousand m^3 water in 2010 according to the data from Ulaanbaatar and other aimags. If service sector's production is increased by 7.6%

annually the water demands are expected to reach 4813.7 thousand m^3 a year by 2015 and 6942.9 thousand m^3 in 2021.

5.6. Tourism

Tourism is crucial for the country's economy and it acts as a bridge connecting countries. It is also an important tool to expand economic, social, cultural and scientific cooperation. Mongolia has a vast territory and many beautiful places and landscapes providing opportunities for the development of tourism. However, to attract tourists the necessary infrastructure needs to be developed.

57.4% of the tourists are from South and East Asia and pacific countries; 37.5% came from European countries.

Figure 42. Tourism in Mongolia

Mongolia's tourism sector is developing by the private sector. The law on tourism was approved in 2000 and relevant regulations, rules and standards were approved as well. By doing so, there has been a comfortable legal environment to develop this sector.

The Government paid much attention to the sector's development and states the following in the Millennium Development Goals-based Comprehensive National Development Strategy: '...develop tourism very intensively and make it a leading sector of the economy...". Also a regional development program for the tourism sector was developed and is being implemented. Each aimag has included relevant measures in their development programs. The Government approved a program to develop tourism in the Khuvsgul-Baikal lake area to develop stable tourism in the area of the lakes Khuvsgul and Baikal in 2008. Mongolia discussed with 2 neighboring countries on recovering a 300-year old "Tea Road" in order to increase the number of incoming tourists and develop transnational tourism. The three countries agreed to co-operate within the framework of the "Tea Road" project in 2009. The implementation has started in 2011. Many more measures are taken to develop tourism.

According to 2010 statistic data, 456.3 thousand tourists visited in Mongolia, which is an increase of 10.9% from previous year. The revenue of tourism sector reached 222.4 million USD, an increase of 4.3% over the previous year.

Table 41. Main indicators of the tourism sector

Indicators	2006	2007	2008	2009	2010	2010/2009
Total foreigners	389,666	453,710	468,655	464,757	557,414	19.9%
of which: tourists	385,989	451,652	447,389	411,640	456,303	10.9%
Tourists by region						
South and eastern Asia Pacific	247,048	286,056	269,646	244,148	261,765	7.2%
European	114,003	149,210	159,884	152,783	171,016	11.9%
America	14,430	14,442	15,817	14,179	16,522	16.2%
Australia	4,732	5,547	5,394	4,431	6,325	43.2%
Africa	502	691	592	482	636	32.0%
Total income of tourism, *million USD*	197.5	227.1	236.9	213.3	222.4	4.3%

There are some 400 organizations with permission to operate in the tourism sector and 2.1 thousand people work in this sector.

Development trends of tourism

The Government of Mongolia has set goals in the Millennium Development Goals-based Comprehensive National Development Strategy as follows:

- develop the necessary tourism infrastructure,
- build large complexes,
- receive some 1 million tourists by 2015,
- intensify development of the tourism sector and
- improve service quality, and increasing tourist number close to that of Mongolian population in the year of 2021.

The Ministry of Nature, Environment and Tourism has developed a program "Tourism" in 2011 to elevate the tourism sector into a leading economic sector by way of developing stable tourism.

According to the program tourism development will focus on 6 regions depending on the regions' features as follows:

1. Ulaanbaatar region: develop trips on business, conferences, and entertainment,
2. Kharkhorin region: develop trips on history, culture, and archaeology exploration,
3. Khuvsgul region: develop trips on nature, water and winter,
4. Khentii region: develop trips on history, culture and sanatorium,
5. Govi region: develop trips on rare animal observation and paleontology,
6. Mongol Altai region: develop trips on culture and adventures

A project to building a new tourism complex "Kharkhorin 13th century" has been implemented to develop the Kharkhorin-Orkhon valley region, which is a birthplace of Mongolian history.

Model tourism complexes will be built in Khalkh Gol of Dornod aimag, Zamiin-Uud of Dornogovi aimag, Khanbogd of Umnugovi aimag, Bulgan of Khovd aimag, and Altanbulag of Selenge aimag. Water supply and sewerage systems need to be stalled that meet international standards to develop tourism. The use of small-size water supply and sewerage system are recommended for the tourist camps depending on location. The best examples are Terelj and Khustai. The introduction of small-size water supply and sewerage facilities in Mongolia needs inclusion in the IWRM plan.

5.7. Economic Development Trend

5.7.1. Economic development trend of Mongolia

To forecast the socio-economic development of Mongolia, it is wise to take account of the impact of global development trends on the development in Mongolia, as well as the impact of positive and negative effects of globalization. By the year 2020 the world economy will have expanded by 80% compared to its size in 2000, and per capita income is likely to increase by 50%. Fundamental changes are occurring in the patterns of global production, trade, employment and wages. For example, in the developed regions with an ageing population, a knowledge/service based economy is the driver for generating revenues, whereas production processes are more and more transferred to developing countries.[30]

Countries in Asia are becoming more integrated in terms of their trade and economic relations, and discussions are underway with regard to establishing the Asian Monetary Fund and introducing a single Asian currency.[31] China, Mongolia's main trading partner, is quickly recovering from the global financial crisis and underpins the growth of the mining sector in Mongolia. Furthermore, the tightening of China's monetary policy has also affect on the growth of the Mongolian economy and[32] the growth can slowdown.

The Millennium Development Goals based Comprehensive National Development Strategy of Mongolia approved by the 12th resolution of 2008 of the State Great Khural of Mongolia comprehensively describes government policy for the next fourteen years. The policy aims at promoting human development in Mongolia, in a humane, civil, and democratic society, and intensively developing the country's economy, society, science, technology, culture and civilization in strict compliance with global and regional development trends. According to this strategy, "Mongolia chooses an export-oriented manufacturing and services dominated, private sector led economic growth and development strategy". The main objective of the economic policy is:

- to achieve, in 2007-2015, the Millennium Development Goals,
- reach an average annual economic growth of 14 percent,
- increase GDP per capita to at least 5,000 USD, and establish the basis for intensive economic development;
- to maintain an average annual economic growth at no less than 12 percent in 2016-2021,
- consolidate and develop a knowledge-based economy,
- increase GDP per capita to a minimum of 12,000 USD,
- create economic capacity and resources to reach the level of the world's middle income countries.[33]
- to rationally manage inflation and maintain annual inflation rate lower than 3 percent and eliminate the inflation pressure on the economy by 2021.

30 Worldbank, Millennium Development Goals based comprehensive national development strategy of Mongolia, 2007
31 Worldbank, Millennium Development Goals based comprehensive national development strategy of Mongolia, 2007
32 Worldbank, Mongolia Quarterly Update, 2011
33 Worldbank, Millennium Development Goals based comprehensive national development strategy of Mongolia, 2007

For the purpose to establish a favorable environment for running businesses, to raise competitive skills in the private sector, to develop mutually beneficial partnership and cooperation between the state and the private sector and to increase jobs and labor productivity the GoM adopted the "National strategy to support the development of the private sector" in 2011. This was one of the relevant measures to support the economic development of Mongolia.[34]

In April 2011, the GoM presented the "Budget statement of Mongolia 2012, Budget projections for 2013-2014" in which it says "In 2011, in the economy of Mongolia is expected to grow 10.8%, the mining sector will grow with 10.6% and the non-mining sector with 10.8%". *Table 42* presents the main macroeconomic indicators of Mongolia till 2015. The highest growth of the mining sector is expected in 2012, reaching 49% and other the sectors' growth ranges between 9% and 12%. In the mining sectors development the "Oyu-Tolgoi" and "Tavan Tolgoi" developments will play a major role. Within the rapid economic growth, inflation is not expected to considerably decrease and the national consumer index is expected to range at about 8-9%.

Table 42. Main indicators of Macro economy of Mongolia

Indicators	2009	2010	2011**	2012**	2013**	2014**
GDP growth, %	-1.3	6.1	10.8	16.6	14.8	15.4
Mining sector	5.8	6.3	10.6	49	24.6	26.1
Non-mining sector	-2.7	6.1	10.8	9.4	11.8	11.7
GDP per capita, 000' MNT	2408.2	2987.2	3603.3	4870	5694.5	6684.1
GDP per capita, USD	1664.8	2420.6	2948	4105.9	4988.6	6084.2
Change of consumer prices, %	4.2	13	9.7	9	8	8
GDP at 2005 constant prices, 000' MNT	3913.7	4154	4601.2	5365.9	6159.4	7106.4
Unemployment* rate, %	3.5	3.1	2.9	2.8	2.7	2.6

Source: www.iltod.mn *Comment:* **Registered unemployment rate*
***Projection*

The rapid economic development and growth of mining provided a favorable condition for achieving the macroeconomic targets of the MDGs based Comprehensive National Development Strategy. In the estimation of the water demand this rapid growth has to be taken into account.

The main social economic development targets of the MDGs goal based Comprehensive National Development Strategy and of the Development strategy by NDIC are presented in Table 43.

Table 43. Main social economic indicators of Mongolia

Indicator	unit	Basic year		Target		
		2006	2010	2015*	2016**	2021*
Social indicators						
HDI	-	0.691	0.763	0.83	0.77	-
Poverty rate	%	32.2	39.2	18.0	18.0	Proportion of the population with medium income to reach 60%
Annual growth rate of population	%	1.3	1.8	-	2.0	-
GDP per capita	*At current prices, 000' MNT*	1440.7	2992.8	6800.0	USD 12 000	USD 22 410

[34] http://www.mad-mongolia.com/news/mongolia-news/

Indicator	unit	Basic year		Target		
		2006	2010	2015*	2016**	2021*
Employment rate[1] [113]	%	11.3	9.9	3.0	6.4	5
Labor force participation rate	%	64.4	61.6	70.0	-	-
Proportion of pupils starting grade 1 who reach grade 5	%	86.8	92.9	100	97.0	100
Infant mortality rate	*Per 1000 live births*	-	20.0	-	15.0	-
Under 5 mortality rate	*Per 1000 live births*	23.2	26	21.0	-	-
Maternal mortality ratio	*Per 100,000 live births*	67.2	47	50.0	-	-
Proportion of population without access safe drinking water	%	60.8	-	40.0	-	-
Proportion of population without adequate sanitation		73.4	-	60.0	-	-
Apartment population with connection to the centralized water supply and sewerage	%	21.4	23.0	30.0	30.0	-
Average number of annually commissioned house units	*number*	8596	8159	10 000	10 000	15 000
Economic indicators						
Annual GDP growth	%	8.6	6.1	14.0	15.0	12.0
Inflation	%	6.2	13.0			Under 3.0
Percentage of the service and industry to the GDP	%	80.5	84.1	85	-	92
Percentage of the export to the GDP	%	49.0	55.7	70.0		
Growth of the mining sector	%				27.6	5.6
Mining and heavy industry — Mining:						
coal	*Million ton*	-	25.1	-	65.0	87.0
gold	*ton*	-	6.0	-	45.0	51.1
iron ore	*Million ton*	-	3.2	-	9.0	20.0
copper concentrate	*000' ton*	-	357.1	-	1 600.0	2400.0
spar	*000' ton*	-	867.0	-	1 000.0	700.0
silver (ore)	*000' ton*	-	0.0	-	350.0	800.0
Mining and heavy industry — Concentrate:						
washed coal	*Million ton*	-	0.0	-	20.0	30.0
coke	*Million ton*	-	0.0	-	2.0	4.0
copper cathode	*000' ton*	-	2 746.2	-	300	135.0
cement	*000' ton*	-	400.0	-	2 000.0	3000.0
metal	*000' ton*	-	0.0	-	500.0	800.0
pure metal	*Million ton*	-	...	-	1.0	2.0
Share of the manufacturing to the industry	%	-	23.9	Increase 4 times	15.6	8
Share of the domestic production to the construction material	%	-	30.0	-	70.0	-
Small and medium enterprises	%	36.6	1.5	Increase 2 times		-
High technological industrial complex	*number*	0	0	-	3	-
State level paved roads	*km*	-	2621	8000	8000	11 000
New railway	*km*		0		1395	-
Energy capacity From which renewable energy	*MW*	- -	856 27	-	2764 439	100% satisfy domestic energy needs
Environmental indicators						
Percentage of the forest	%	8.44	8.38	9.0	9.0	-
Proportion of protected surface water sources	%	50.0	90.6	80.0	-	-

Indicator	unit	Basic year		Target		
		2006	2010	2015*	2016**	2021*
Number of protected and rehabilitated water sources	*pcs*	229	145 (total 730)	1000	-	-
Proportion of the remediated area	%	-	54.0	-	60.0	-
Tourism						
Number of the foreign tourists	*000' persons*	386.0	465.3	1 000.0	1 000.0	Reach to the population number

*Comment: **MDG based Comprehensive National Development Strategy*
**Main Development directions from NDIC*
[1]Methodology for estimation unemployment rate was changed in 2009.

Although the economy of Mongolia has potential for development it is necessary to pay attention to some risks. For example the poorly maintained infrastructure may have a negative impact on economic growth. Till now the budget for operations and maintenance is completely inadequate to preserve the quality of existing infrastructure.[35] Also Mongolia has relied on Official Development Assistance (ODA) to finance most of the infrastructure requirements. Grants account for a huge portion of infrastructure financing. As the economy grows, donors will inevitably lose their status as the primary financier.[36] Foreign grants and soft loans will decrease and investment costs will increase. Nevertheless, the targets of the MDGs based Comprehensive National Development Strategy are optimistic regarding the investments necessary for this compared to the budget, regarding the growth forecasts of the IMF, regarding the still struggling global economy (although China and Russia are quickly recovering) and regarding the current local constraints to growth [71].

Economic sectors development[37]

Mining: Mongolia's mid-term objective is to put natural resources and raw material deposits into economic circulation. The investment in this sector will increase dramatically between 2013 and 2015. Oyu Tolgoi's copper and gold production will start soon and copper concentration production will start from 2013. In 2013, Tsagaan Suvarga copper and molybdenum deposit extraction will begin. The cathode copper industry will be started in 2014. Within the framework of Ukhaa Khudag project, 3-unit coal enriching factory will be put into use in 2012, which has washing capacity of 5 million tons of coal annually.

The following deposits will be used in the mid-term: Tsagaan Suvarga copper and molybdenum deposit extraction will commence in 2013, coal-washing industry will be constructed at Nariin Sukhait. Also planned to start use Dulaankhaan uranium deposit and construct the yellow powder industry.

Heavy industry: the future objective of Mongolia's mining sector is to produce final products and export them. Within the framework of this activity, the Government of Mongolia made a decision to construct "Sainshand" industrial complex. The industries' technical and economic basis will be developed in 2014 and construction work will be conducted between 2015 and 2019. The following industries will be constructed in Sainshand: coke, metal, coal, copper melting and construction material industries.

35 World bank – PPIAF, Rethinking the delivery of infrastructure services in Mongolia, 2007
36 UNDP, Mongolia Common Country Assessment 2007-2011, 2005
37 Official document from NDIC

The "Dornod Oil" refinery with state investment share will be established in Choibalsan city of Dornod aimag.[38] In addition, a refinery with a capacity to process 2 million tons of crude oil per year[39] will be constructed with state participation in Darkhan Uul aimag and a refinery with a capacity of processing 1 million ton of oil per year will be built in Sainshand industrial park.

Based on local area chalk deposits, two cement factories with a capacity of 1 million ton and three cement factories with a capacity of 100,000 ton will be newly constructed. Technological renovation will be conducted in the Khutul cement and chalk factory. The total cement demand will be supplied by domestic production. In order to have supply of ferro concrete materials, a tensilend technology-based ferro concrete material factory is planned in Ulaanbaatar city; polyester concrete industries are planned to be built in Dornod, Zavkhan, Uvurkhangai and Khovd aimags.

Energy: A thermal power plant with a capacity of more than 400 MW based on the Tavan Tolgoi coalmine and a thermal power plant with a capacity of 450 MW near Oyu Tolgoi deposit will be constructed in order to supply strategic important mines and industrial complexes with energy between 2013 and 2015. A fifth thermal power plant will be constructed in Ulaanbaatar city. In order to increase use of renewable energy a 300-350 MW capacity hydropower plant will be built on the Selenge River and this activity is included in the 2013 main direction of economic development.

Other economic sectors: Within the framework of food industry, "Food Safety" national program implementation will be intensified, food products' quality and safety will be improved and population demand will be supplied by domestic production. Based on raw material location, resources, regional features and infrastructure development, 23 light and food industries will be constructed through concession agreement. It is planned to develop knitting and sewing production and wool-cashmere processing factories and introduce technological methods in the tannery sector. In the agricultural sector, the Mongolian Livestock national program will be implemented, the domestic grain, potatoes and vegetables demand will be supplied and agricultural products will be exported.

5.7.2. Economic development scenarios

The main purposes of water management are the preservation, protection and rational use of water resources and to promote sustainable social-economic development. For this, it is necessary to determine the available water resources and the future water demand.

The water demand depends on population growth, economic growth and economic sectors development. The prediction of the future water demand is complicated because a country's economy cannot develop independently and carries risks because it depends on the world, regional and other countries economy. The water demand is related to the economical development as for example, when the economy is growing it will improve the welfare and more people will live in apartments. Related to this, more households will use water meters and will reduce water losses. As a result apartment household water consumption will decrease. However related to the economical growth ger areas households' water consumption will increase.

The project defined three scenarios for the economic development of Mongolia based on policy documents and IMF, WB and ADB estimates: the optimistic scenario (high economic growth), the medium (or baseline) scenario (most realistic figure of economic growth) and the pessimistic scenario (low economic growth). These scenarios will be described below.

38 Government resolution number 222 from July, 06, 2011

39 Government resolution number 294 from October 12, 2011

High scenario

The optimistic scenario is characterized by high economic growth. This growth is stimulated by capitalizing other deposits in the mining sector and continuing high copper and gold prices.This will have a big impact on water demand, although the mining sector does become more efficient in their water use, as water reuse is increasing.

Moreover, in this scenario the expected economy becomes more balanced, with growing manufacturing and construction sectors as well. The manufacturing sector is increasing due to the presence of more high end products made of the available minerals in Mongolia. The growth of the construction sector is caused by the increase in investments in infrastructure and buildings by both the public and the private sector.

Investments in infrastructure can be carried out due to the increasing Government budget because of economic growth and the resulting tax income increase. Furthermore, because of the improving infrastructure and stable economy, Mongolia has become very interesting for private sector financing, which is a good alternative to grants, as these are decreasing due to the economic growth.

Other sectors that are growing are the energy sector, due to Government investments therein because there is a necessity to increase its capacity, and the tourism sector. The tourism sector grows due to better infrastructure, an increase in information about Mongolia to other countries and the continuing growth in the rest of Asia. Finally, the services sector is growing because of increasing real wages and decreasing unemployment, meaning that the people can afford to consume more. Inflation is kept under control due to a strict budgetary policy of the government and central bank.

The presence of the main economic sectors in the urban areas further stimulates urbanization. In this scenario, the GoM is successful in its strategy to shift people from ger areas to apartment areas, meaning that the percentage living in ger areas and in apartment areas has been turned around, reaching the 85% as aspired by the Government. This also means that most people now are connected to the central water supply. To keep a cap on the growth in domestic water consumption, the GoM has decided to increase the number of individual meters. Moreover, drinking water companies have been successful in rehabilitating the water supply networks, thereby decreasing Non Revenue Water. Due to these developments and the increase in pro-poor planning of the GoM, the gap between rich and poor is decreasing, and more specifically, less people live below the poverty line.

A summary of these characteristics is presented in the table below.

Table 44. Characteristics of the high scenario

Characteristic	Average growth rate in year, %	Explanation
GDP	14.0	MDGs base CN development strategy
Mining	23.0	
Construction	10.0	
Energy	10.2	
Manufacturing	12.6	http://www.economywatch.com/world_economy/mongolia/economic-forecast.html
Service	14.5	
Municipalities	4.0	
Tourism	7.5	
Agriculture	7.1	Regional development program
Inflation	5.0	From 2014
Apartment households		80% of urban population, (based on MDGs base CN development strategy)
Water loss		Reduce to 10 % (Based on previous surveys)

The urbanization trend will have a direct effect on the countryside. Here, agriculture will become more efficient because the arable land area per "owner" becomes bigger, resulting in more efficient irrigation (more crop per drop), also due to the investments made by the GoM in this area. Livestock's growth will almost completely come to a hold, growing in line with the population growth in the country side, due to the decrease in people that adhere to the nomadic lifestyle. This trend is further stimulated because bigger herds cannot be sustained by the environment, which is acknowledged by the policy makers both on national and local level.

Medium scenario

The Mongolian economy will be considerably dependent on mining sector development, which large affects from export and World market and maybe faces some economic risks. For example, decrease of demand on mining products will reduce not only mining sector growth it will affect on economic growth of Mongolia.

Moreover were reviewed regional policy documents, which are planned economic development of economic regions by sector. Most average growth of the sectors was planned higher than economic growth trends based on previous years. Because according the mining sectors development Mongolian economy start develop rapidly.

Table 45. Characteristics of the medium scenario

Characteristic	Average growth rate in year, %	Explanation
GDP	10.0	Regional development programs
Mining	14.5	
Construction	6.9	
Energy	6.0	
Manufacturing	6.9	
Service	6.9	
Municipalities	1.4	
Tourism	6.8	
Agriculture	4.5	Regional development program Previous development trend
Inflation	8.0	State Budget prospect of Mongolia to 2014
Apartment households		72% of urban population, (lower than 10% from high scenario)
Water loss		Reduce to 15% (Based on previous surveys)

Low scenario

The "Dutch disease", that is warned for by the ADB and the World bank, indeed develops in Mongolia, in which rapid increases in exports of minerals put upward pressure on the exchange rate and inflation, draw resources away from non-mineral sectors, and generate a stream of government revenue available for subsidies and handouts. The outcome is uncompetitive non- mineral industries and overextended government budgets as global mineral prices have turned down.[40] Moreover, agricultural sector, which employed many workers, highly affects from climate condition. That causes higher risk at a present, when faces climate change.

Economic growth is mainly based on mining activities, which is also a risk, as a decrease in mineral prices will affect the complete economy of Mongolia. Nevertheless, manufacturing and the services sector also become big players in the economy, due to increasing wages and decreasing unemployment. Nevertheless, inflation takes it toll from this increase as in this scenario the GoM is not able to have this figure decreased

[40] ADB, Mongolia Development Outlook, 2011

significantly. It does not increase much either though. This mainly hurts the poor people. Consequently, the gap between rich and poor does not disappear, but remains stable due to the effort of the GoM to improve the life of people living below the poverty line. This consists of better infrastructure supplies in ger areas, for example with an increase in the number of water supply kiosks and all kiosks will have to connect to the central water supply system.

Another cap on the economic growth in this scenario, are the assumed capacity limits in terms of (skilled) human resources and energy for example, limited government budget (decrease in grants and soft loans due to economic development, without having it replaced by private financing), absence of priorities concerning in what projects to invest, little attention to operation & maintenance of infrastructure and increase in corruption.

In the low scenario has used previous trend of economic growth. This means that manufacturing will end up with an output of about 230 billion MNT in 2021, services at 2,500 billion MNT, agriculture at 850 billion MNT, and mining at 2,200 billion MNT. Furthermore, the public sector will end up at 340 billion MNT, the construction sector at 55 billion MNT and the energy sector at 140 billion MNT. The tourism sector will grow to receiving 820 thousand international arrivals per year in 2021

For determining the low scenario trend lines were created based on figures from the period 1996-2009. The trend lines are visualized per sector in the figures below.

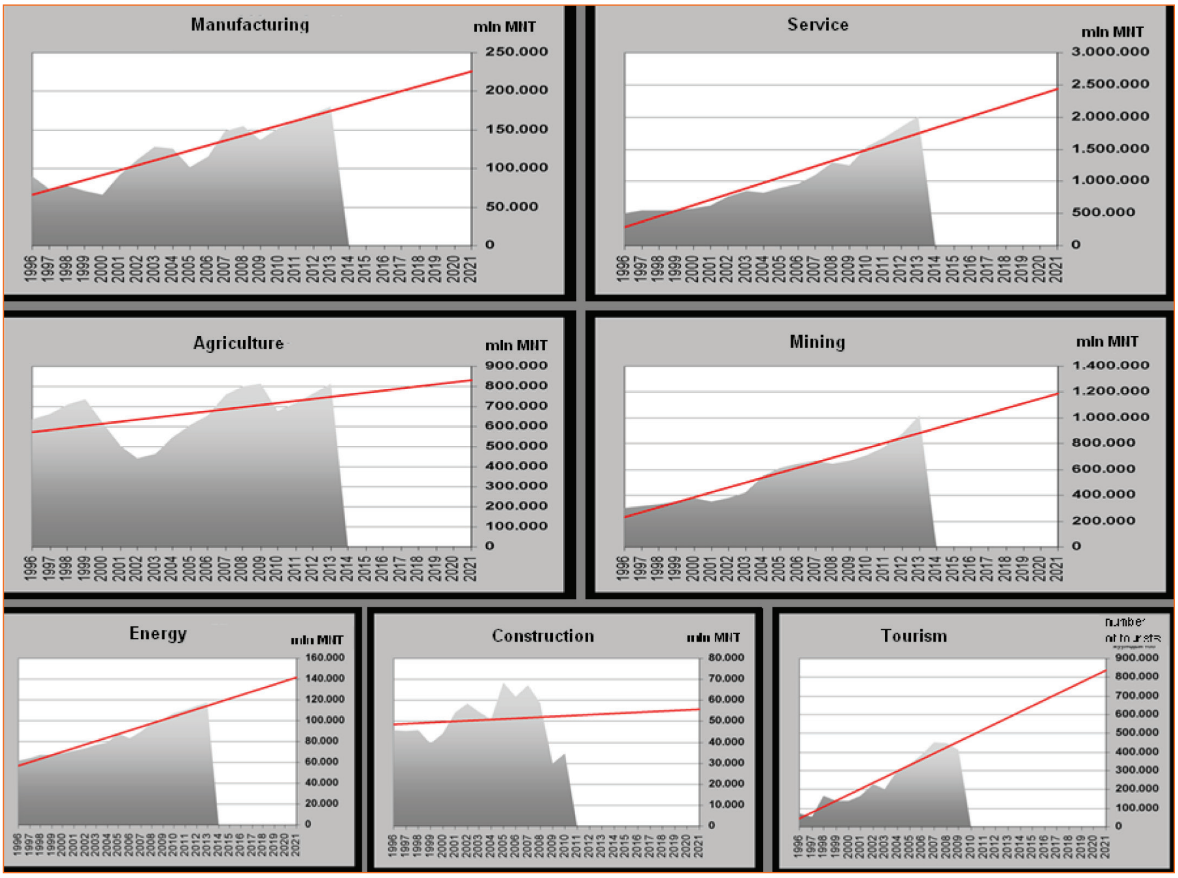

Figure 43. Past and forecast GDP output of the manufacturing sector at constant prices (million MNT)

The objective to move more ger area inhabitants to apartments has become reality, although the objective of the GoM is not achieved. This is also due to the increasing influx of people from the country side, as most employment can be found in urban areas.

Another cap on the economic growth in this scenario, are the assumed capacity limits in terms of (skilled) human resources and energy for example, limited government budget (decrease in grants and soft loans due to economic development, without having it replaced by private financing), absence of priorities concerning in what projects to invest, little attention to operation & maintenance of infrastructure and increase in corruption. Furthermore, the copper and gold prices are assumed to be lower and less stable than in the high scenario due to instable global economic growth and more specifically in Asia.

As far as agriculture is concerned, the number of crops. Also the livestock sector will grow with bigger herds per herder, and completely recover from the losses from last winter. Nevertheless, the growth will not be as big as after previous dzuds, due to Government policy and capacity limits in terms of available land and herders.

A summary of these characteristics is presented in the table below.

Table 46. Characteristics of the medium scenario

Characteristic	Average growth rate in year, %	Explanation
GDP	6.0	Based on previous development trend
Mining	10.5	
Construction	4.0	
Energy	2.5	
Manufacturing	4.0	
Service	4.5	
Municipalities	0.7	
Tourism	6.0	
Agriculture	2.2	Lower than 50% previous development trend
Inflation	9.5	State Budget prospect of Mongolia to 2014
Apartment households		65% of urban population, (lower than 10% from medium scenario)
Water loss		Reduce to 17% (Based on previous surveys)

6. Water pricing

6.1. Water tariff

The water tariff is an important economic tool for water demand management. The water tariff is the financial leverage for an effective water distribution, and a wise use of water. Nowadays, users pay service cost only. In other words, usually the price of water is set below the actual cost.

Increasing the water tariff may be important as an economical tool but also has a weakness for society. It is a delicate issue, as it may result in low-income families to decrease their water use, resulting in potential health related problems.

In Mongolia, people seem to go by the idea that water supply is unlimited, eternal and free of charge and that water is a gift from nature. It is necessary to change this understanding because every person has to pay for their water usage. Water fees and tariffs have a significant impact on the water use efficiency, successful water resources management and effective distribution of water.

Through the Law on Water (2004), the principle of paying for water was introduced in Mongolia. As per article 15.1.3, the Local Representatives' Khural is responsible for establishing the price for water services. It is not specified though what expenses should be compensated and what items would be subsidized. Due to this, water organizations may operate at a loss with all its consequences such as lack of operation and maintenance, resulting in malfunctioning, leakages and/or a decline in water quality. A good water policy with effective tariff setting methodologies is therefore an important aspect for the improvement of water supply, equal distribution of water and wise use of water.

The human basic rights are guaranteed by the country's Constitution. People do have sufficient drinking water, and the human rights to have safe water and adequate sanitation facilities. This does not match with rights to live in healthy and comfortable environment. The low-income families pay much money for healthcare needed due to poor conditions of water supply and sanitation facilities.

Currently in Mongolia, water tariffs are lower in places with more water resources. The Aimags can be distinguished as those with many water resources and higher water tariffs and those with insufficient resources and with lower tariffs. For example, high water tariffs can be found in Arkhangai, Khentii, Zavkhan and Khuvsgul. The city of Ulaanbaatar, and Darkhan-Uul, Orkhon and Umnugovi Aimags have a high population number and few water resources, but water tariff is lower. The figure and table below present the tariffs per Aimag and the available water resources in that Aimag.

The local administrative units are responsible for the tariff policy. According to the Water Law, the Local Representatives' Khural is given the right to establish the price and reform it at will. This is good for price regulation in rural areas and for decentralization. On the other hand, some tariffs show that the system is not always functioning well, with people not paying the actual cost of water.

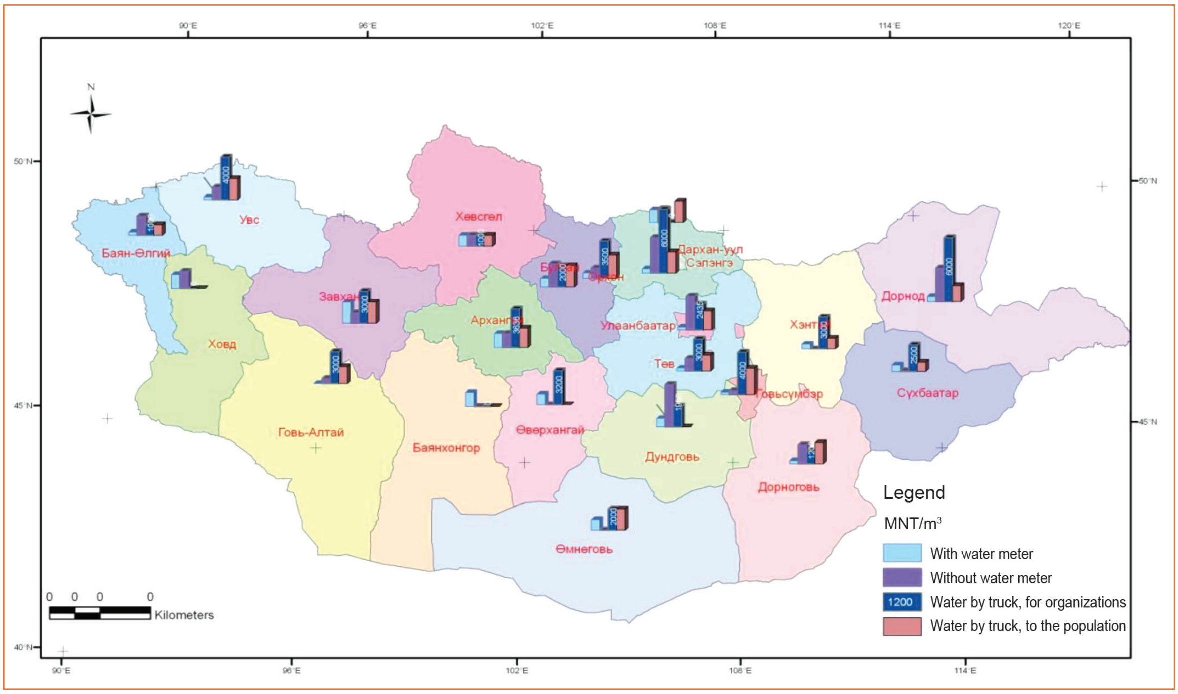

Figure 44. Water tariff standard of Ulaanbaatar city and Aimags, 2008

Table 47. Water tariff of the aimag centers, 2008

№	Aimag and capital	Water resource, km³	Water tariff, MNT/m³
1	Arkhangai	2.68	1800
2	Bayan-Ulgii	2.48	1000
3	Bayankhongor	1.41	945
4	Bulgan	1.75	980
5	Govi-Altai	0.94	1500
6	Govisumber		2000
7	Dornogovi	0.25	1500
8	Dornod	1.7	1500
9	Dundgovi	0.125	2000
10	Darkhan-Uul	0.044	1500
11	Zavkhan	3.41	2000
12	Orkhon	0.005	2000
13	Uvurkhangai	0.56	2000
14	Umnugovi	0.73	1000
15	Sukhbaatar	0.21	870
16	Selenge	3.02	990
17	Khovd	1.39	1000
18	Khuvsgul	5.99	1000
19	Khentii	2.94	1500
20	Tov	3.21	650
21	Uvs	0.98	2000
22	Ulaanbaatar	0.77	909.9

Currently, the water tariff is fixed on the basis of extracted water cost, electricity and work force expenses as well as maintenance cost in some cases. The water tariff does not compensate the actual cost of water as it does not include the economic price of water, cross-subsidies and depreciation of the assets, and sometimes operation and maintenance are not included as well. This means that the water supply and sanitation organizations in Mongolia have little opportunity to recover investment costs and they have to be subsidized. The accumulation of depreciation fund is insufficient to cover the cost of operation and maintenance to support the facilities' regular operation.

Ulaanbaatar and aimag center ger areas without connections to the central system do not have a centralized heating system either. These ger areas have a poor electricity supply and do not have sewerage. The foreign institutions do demand a reduction of the labour force and an increase in revenues e.g. through more effective tariffs.

6.2. Water Fee

The distribution of the water resources in Mongolia is unbalanced. Sometimes the lack of adequate water resources works as an obstruction to stable social development. Due to global warming and human activities, water scarcity and pollution occur.

The water fee calculation in Mongolia was based on the "Temporary norm approval order 153"№ by the Minister of Environment of 18 November 1995. In addition, there is a Government resolution regarding the water resources use fee collection in the state budget and its expenditure on natural resource rehabilitation and protection. The implementation of the following Government laws should be monitored:

- The law on water;
- The law on water resources use fee;
- The law on water use fee percentage reform;
- The law on the amount of natural resources use fee revenues to be spent on natural protection and natural resources rehabilitation.

According to the law on the amount of natural resources use fee revenues to be spent on natural protection and natural resources rehabilitation, at least 35% of the water use fee income is to be spent on water and forest resources protection.

Surface and groundwater are used for the extraction of various natural resources like gold, copper, oil, precious metals, uranium, phosphor, precious stones and construction material minerals.

The number of entities in the mining sector that used surface and underground water between 2005 and 2010 is presented in Figure 45.

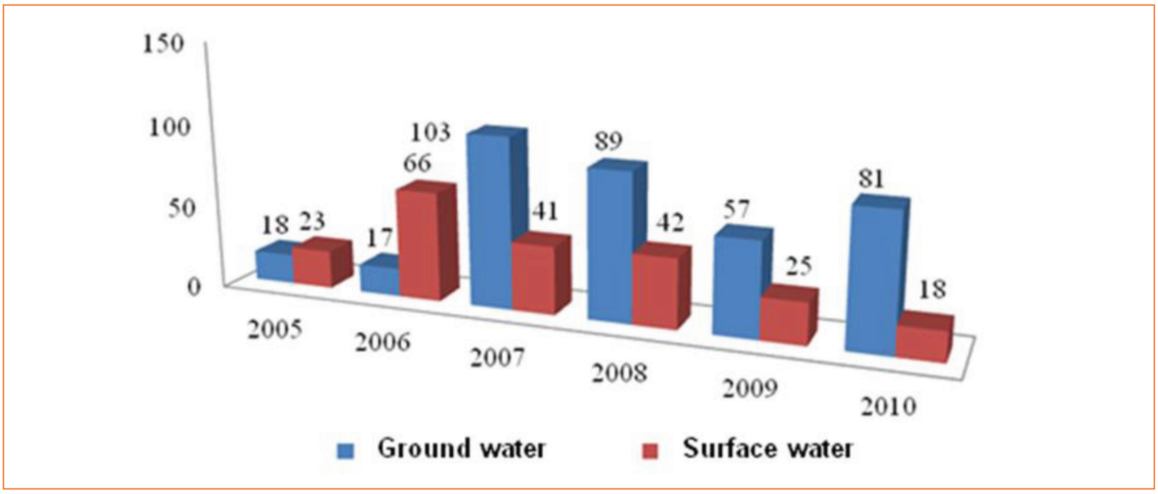

Figure 45. Mining sectors water use

Given the large share of the mining sector in the Mongolian economy, water has a high economical benefit and it needs to be protected, rehabilitated and saved.

The mining industries water demand is high. However, it is water use fee is low and the mining industries are supplied with low-cost water. Due to this low-cost water supply, the wise use of water is not a high priority for the mining industries.

Water use fee policy

The natural resources use fees (land use, hunting resource use and natural plants use etc.) are a commonly used economic tool for wiser usage and protection of the natural resources. The natural resource use fee does not have any business objectives and it is used for natural resources protection. Other measures that are used as economic tools for natural resource protection are contamination fees and licensing.

Practical examples of water fees in Mongolia are the following. As per clause 26.1, chapter 3 of thewLaw on Water, the Government agency in charge of water issues has to grant permission for water usage over 100 m^3 per day and for creating wells, artificial lakes and/or channels. Furthermore, citizens, entities and organizations have to pay a fee for water and spring resources use as per the law on water and spring resources use fee. In article 7 of this law, the fee amount and fee limits are defined.

As per article 9.2 of the law on water resources use fee, the payer defines the total amount of water used and pays a corresponding water use fee to the budget and the water fee amount defined by Water Authority for large users and for other local Environmental department. The largest part of the water resources use fee goes directly to the State budget and a small amount gois to the local budget on the basis of clause 10, article 5 of the law on the ”2010 budget of Mongolia”. The figure below shows the increase in revenues stemming from water in the State budget.

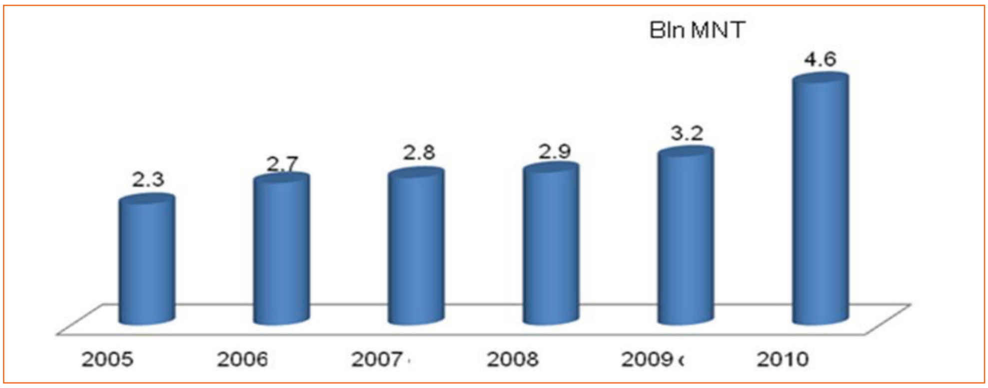

Figure 46. Water income flowing into the state budget

6.3. Natural Resources Use Fee Revenues and Its Composition

The natural resources use fee is regulated by the law on “Government specific fund item 4”. Here it is specified that an equivalent to at least 70% of the timber and firewood harvesting fee revenues, at least 20% of the land fee revenues and at least 35% of the water and spring resources use fee revenues must be spent on land, water and forest protection and restoration as reflected in the general policies on economic and social development. Some 20% of the water and spring resources use fee is collected into Soum budget and 80% into Aimag budget. The Table 48 shows the various fees and the percentage to be spent on protection and restoration.

Table 48. Extent of fee revenues

Type of natural resource use fee revenue	Minimum mean percentage of fees to be dedicated to environmental protection and natural resource restoration /by percentage/
1. Natural resource use fee revenues	30
2. Game resource use fee revenues	50
3. Land fee revenues	30
4. Timber and firewood harvesting fee revenues	85
5. Water and springs use fee revenues	35

The revenue of gold and coal use fee is collected and deposited to the state budget. The amount of water use fee is based on the Law on ''Water'', the law on ''Water and springs resource use fee'' and the Mongolian Government resolution №351 of 2009 ''Estimate of water use fee amount''. As reflected in item 3.1 of the law on '' Investment Percentage of Revenue generated from Natural Resource Usage Payments for Measures to protect environment and rehabilitate natural resources'', the money equivalent to certain amount of the natural resource use fee revenue is included in the fee revenue part. That amount is distributed for the purpose to protect and restore nature in the budget year.

Natural resources use fee revenues as informed by the General tax office on 2006-2010 are presented in *Table* 49.

Table 49. Revenue of Water and spring use payment,in 000' MNT, 2010

№	Tax office	Revenue
Total		4,716,837.5
1	Arkhangai	100,889.7
2	Bayan-Ulgii	1,663.7
3	Bayankhongor	82,981.0
4	Bulgan	1,781,255.4
5	Gobi-Altai	11,613.9
6	Dornogobi	38,044.3
7	Dornod	233,297.0
8	Dundgobi	7,729.8
9	Zavkhan	7,251.5
10	Uvurkhangai	276,515.6
11	Umnugobi	97,201.5
12	Sukhbaatar	63,776.1
13	Selenge	479,264.9
14	Tuv	421,179.9
15	Uvs	8,303.6
16	Khovd	12,488.2
17	Khuvsgul	6,375.0
18	Khentii	102,835.1
19	Darkhan-Uul	199,809.6
20	Orkhon	2,161.2
21	Ulaanbaatar	485,425.3
22	Gobisumber	1,211.7

6.4. International experience on water tariff and fees

Every country has a method to estimate water tariffs and fees depending on the socio-economic environment and development standard. It is necessary to determine the basic methodology for estimating water tariff and fees.

Tariff system principle of urban water supply system

The following three basic objectives should meet when determining water tariffs:

1. *Cost recovery*
2. *Economic profit*
3. *Buying power*

There are some additional objectives that need be considered for establishing water tariffs and fees. For example, the water tariff mechanism should be comprehensive and it should be possible to implement it, meaning that it should be approved by politicians, the public and decision-makers.

Tariff types

The tariff structure is the structure in which the monthly water use fee for all social groups of water consumers is estimated based on service conditions and type of user. International experience shows that there are two basic structures for domestic water supply: the “1-sided tariff” and “2-sided tariff”. The 1-sided tariff uses one calculation method when estimating consumers’ monthly water use fee. The 2-sided tariff uses two calculations like a combination of a fixed fee and fee dependent on the amount of water used. The water tariff is described in detail in the “Water pricing” handbook of the project.

The fixed tariff structure is the most suitable when there is no water meter to meter water. As for the fixed fee, consumers’ monthly water fee stays stable and does not fluctuate with the amount of water that is used. In some countries, high-rise apartments do not have water meters and consumers pay a fixed fee. This kind of fee also still exists in some industrialized nations, like Canada, Norway and Great Britain. In Mongolia there are also some households connected to the central water supply system that pay a fixed fee since they do not have water meters. For example, the households in Bayan-Unjuul Soum of Tuv Aimag pay 1000 MNT per month. The fixed fee can be adapted to various consumer groups, based on their specific characteristics. For example, in the past people who live in luxury houses had to pay more as it was assumed that they use much water and have the ability to pay for it. Furthermore, the industries were imposed higher fixed fees than households, because industries use much water and they are better able to pay for it. Another trend is to impose a fixed fee that is dependent on the diameter of the water pipeline.

From the point of economic profit, the fixed fee tariff system has a disadvantage. The actual water used exceeds the estimated demand is free of charge so that people do not have economic an interest in wise use of water. In addition, the water supplier may have economic difficulties as a 1-sided tariff based on fixed fee gives consumers the opportunity to pass on water to other people or businesses, who do not have a water connection, without being confronted with a higher price.

Another possible fee is a fee that varies with the amount of water used. There are three possible tariffs that may be used: a. fee based on fixed unit costs; b. block tariff; and c. linear tariff.

USA, Australia and some European country have used fixed unit costs for industrial water users and for water vendors. The advantage of this system is that it is easy to understand for the consumers. From the point of economic profit, it gives easy-to-understand information on water usage surplus value. Also in Mongolia for the users with water meters this tariff structure is used.

The increasing-block tariff is commonly used in Spain and in countries in the Middle East facing water scarcity. The advantages of a block tariff are that it gives low-income people a chance to have water supply service at minimal fees. Furthermore, increasing the unit fee per cubic meter stimulates wise water use. Finally, water suppliers will have the possibility to compensate their expenses. The decreasing-block tariff: unit cost is high where little water is used and decreases when a certain limit of water usage is reached.

The increasing-block tariff system is commonly used in Europe. Some water specialists consider that it is the most preferred system. But in reality, if the tariff amount is established incorrectly, the above mentioned three goals will not be achieved. For example, when low-income households do not have their own water meters and thus have to use a public one. This may cause fees to be higher, due to higher use of other households.

The decreasing-block tariff is used to support high-water-demand manufacturers and in conditions where natural water resources are abundant. This system was used in some cities and states of Canada and the United States, but it is becoming less and less common due to the principle of surplus value and sustainability concerns.

The linear tariff is used rarely. In this system, the consumer's water fee increases when water usage increases. The extra unit is sold at different cost and it does not give consumers a clear economic perception on the cost of water. The reason is that water suppliers' surplus value does not scale up as each household's water demand increases.

Recently, 2-sided tariffs are commonly used. As for the 2-sided tariff system, the consumer's fee is calculated by adding a fixed fee to a water volume-related fee. The same type of tariffs can be used as in the 1-sided tariff. 2-sided tariffs play an important role in the compensation of the expenses of water supply organizations. The short-term surplus value of water supply can be very low, making it suitable for water tariffs to be low, equal to short-term surplus value. As for 1-sided tariff systems, establishing very low water tariffs causes a compensation failure of total supply expenses. For the 2-sided tariff system, sufficient income can be generated through the fixed fee without any influences on the basic principle of water metered-fee. When there are scarce water resources, short-term surplus value-modified cost should absorb the lost-chance expenses of consumers who are unable to buy water. The scarcity cost makes the water metered-fee higher in order to supply consumers with the remaining resources.

At present the Mongolian water supply organizations study to introduce 2-sided tariffs.

In some cases, water supply cost varies depending on the seasons. The water supply is high in the rainy season. In the dry season, water supply may be insufficient. It is economically beneficial to establish water prices in relation to expense structures. In other words, establish a high price in the dry season and a low price in the rainy season. It gives a perception to the public that water supply cost is not fixed. Chile is one of the developing countries that uses this seasonal water tariff system.

The regional tariff setting is a method, which imposes a fee that is different due to the absorbing expenses for consumers' water supply in different regions. Supplying consumers who live far from water supply source causes for distribution and transportation cost increase.

Table 50. Water tariff methods, in percentage

Countries	Fixed fees	Water metered-fixed fees	Increasing-block tariff	Decreasing-block tariff
Australia	-	68	27	5
Canada	56	27	4	13
France	2	98	-	-
Hungary	-	95	5	-
Japan	-	42	57	1
The Netherlands	7	90	3	-
Norway	87	-	13	-
Spain	-	10	90	-
Sweden	-	100	-	-
Turkey	-	-	100	-
Great Britain	90	10	-	-
USA	2	33	31	34
Mongolia	60.6	39.4	-	-

In *Table 50*, four basic tariff structures are presented with the countries that adhere to these structures. Many tariff structures are used throughout the world with the water metered-fixed fee system being the most prevalent.

Internationally the concept for water pricing is usually laid down in a law. For example: in the Chinese law on water, article 55 states the following: "...when establishing water supply and usage fee, the following concept is followed: to compensate operational cost, to earn income and to earn expenses for improving water quality". Mexico is one of the countries that started implementing integrated water resources management. In 1999, the concept for estimating the water use fee was formalized in the law on water. It says that:

- To compensate operational cost related to water service and water supply
- To implement integrated water resources management and raise fund for solving sector-related issues
- To spend water usage fee on improving water sector organization

6.5. Renewing the Water Pricing System

6.5.1. Current Situation

The water price in Mongolia consists of a water resource use fee, a service fee (tariff) of water supply organizations and subsidies. And the polluter pay principle is just in the beginning. If water is polluted, polluter should pay compensation according to the rules.

According to the Law on Water, water use is classified like water consumption and use. The water consumers are paying water service charge and water users' are paying a water resource use fee.

1). *Water and waste water tariff*: The public utilities services and companies of cities and local areas, which operate in the business of discharging waste water from utilities and mining as well as distributing fresh water, establish fees based on the rules which are obeyed on the basis of discussion with local Representatives' Khural and the Agency for Fair Competition and Consumer Protection. According to the "Law on Urban and settlement area water supply and sewerage use", which is newly approved in 2011, the Council, which manages Urban and settlement area water supply, sewerage use and services, will approve and monitor the water tariff and water pricing methodologies.

Usually, water supply and sewerage companies are a monopoly at the local level. Some private water vendors work in ger districts and soum centers. But there are not many and the ability to compete is weak.

The local area administration participates in the water fee establishment. On the one hand, it has the advantage to prevent a monopoly condition, but on the other hand, organizations that operate in the sector suffer from loss due to fixed fees and tariffs. The negative effects are budget pressures and organization bankruptcy. As for expense returns, water supply organizations barely recover operating expenses and depreciation, and in some cases, do not manage to compensate operating expenses at all. It makes water unproductive in economical terms.

The local area Representatives' Khural establishes borehole water fees in soum centers and small urban areas. The tariff is established low compared to the costs and there are few consumers. It leads to small amounts of income, which barely compensate operating expenses. The livestock watering boreholes are built and renewed by budget assets and compensation of expenses is hard. The issue is solved in a way that the herders' groups own them.

2) *Water resource use fee*. The water issue is one of the basic factors that create a stable development of Mongolia. Our country's water resources have an uneven distribution in terms of space and time. It leads to some obstacles when creating a stable social development. According to the Law on Investment Percentage of Revenue generated from Natural Resource Usage Payments for Measures to protect environment and rehabilitate natural resources, from total revenue of water use fee 35% or more must be spent to protect and rehabilitate water resources. The local area administration should allocate some amount of money for the activities to protect and rehabilitate water resources. But, that amount of money is not spent in a useful way.

   For example: water resource use fee income reached MNT 4.72 billion in 2010 and MNT 1.1 billion were spent on water sector management (water sector administration, water resources research and protection) which is 23.8% of the total income.

3) *Water pollution compensation fee*. Mongolia's economy is booming and water use increases. Also pollution is increasing along with it. The main reasons of the water pollution are growth of construction material industry, mining and raw material processing industry as well as population concentration and urbanization.

   The polluter pay principle is in its initial stage and there is a 1992-approved compensation rule on water pollution. Its implementation is very imperfect.

4) *Subsidy*. The water sector requires a lot of subsidies and aid every year due to the low income and insufficient compensation of water supply organizations' expenses. The subsidies are mainly used for population water supply, sanitation and agricultural water supply. In Mongolia, mainly the direct subsidy principles are used.

6.5.2. Possibility to Change Water Pricing System

The Mongolian water sector structures are being changed and renewed due to the changing economical situation. It is required to renew water pricing structures, which are the main economic condition for the sector's existence. The water fee policy acts as a main leverage for water resources, especially water demand management finance and economy. The following changes should be done systematically for fee forming structures in order to have successful water sector activities based on other countries' experience and the research works conducted within the framework of relevant organizations' recommendations.

The price of water is a key determinant of both the economic efficiency and the environmental effectiveness of water services. A water tariff is a powerful and versatile management tool. It is capable of promoting a number of objectives, although tradeoffs among them are commonly required. When specifying a water fee and tariff, the following common objectives should be defined. They are:

- Economic efficiency, resource conservation
- To meet state policy
- Cost recovery and net revenue stability
- Equity and fairness
- Public acceptable
- Simplicity and transparency
- Taking into account the consumer purchasing power

The fee and tariff types and their basic principles that can be used for the fulfillment of the above mentioned objectives are presented in *Table 51*.

Table 51. Water fee and tariff types andhprinciples, which can be used further

Type of price	Scope	Main principle	Payer
Water and wastewater tariff	Water supply service	Consumer cost pricing	Consumer
Water resource use fee	Water use amount	Interest-pay- say	Users
Water tax	Water system	Public, differential	Consumers and users
Water pollution fee and compensation	Water quality	Polluter pays	Polluter
Subsides	Water supply service O&M and capital cost	Based on cost recovery	State and local budget, investors and donors

Water will be productive in terms of society and economy in case there is full cost recovery or close to full cost recovery.

1) Water and waste water service tariff: Water pricing principles need to be chosen in relation to state policy. The cost recovery issue is the most important principle when specifying water fees according to privatizing and changing directions of national development concept of Mongolia and public utility service sector.

According to other countries' experience, the cost recovery level of water is established by laws and rules. It becomes the main condition of cost sharing and reliable operation of water supply organizations. It is very important to determine other water related fees. So it is important that the expense compensation level of water is discussed by the relevant organizations in relation to state policy and is formed by special rules. Those relevant organizations are MRTCUD, MNET, WA, MFALI, MF, and the Council for regulation of the urban and settlement area water supply and sewerage use and services. The following organizations need to be involved when establishing fresh water and waste water fees and tariffs. They are MRTCUD, the Council for regulation of the urban and settlement area water supply and sewerage use and services, local area Representatives' Khural, AFCCP and utility organizations.

Fees and tariffs should be based on consumers' interests and they should contribute to new investment conditions and water service organizations' existence.

2) Water resource use fee. The following organizations should participate in the establishment of water resource use fees, water taxes, water polluting fees and compensations. They are MNET, which is responsible for water resources and quality issues; WA; MF; GASI; GDT and local area Representatives' Khural. The main objectives of the fee are to use water resources wisely, to increase use benefits, to provide ecological balance and to protect and rehabilitate water bodies. The fee income is spent on the following things. They are to use water resources wisely, to finance activities to rehabilitate and increase water bodies (water resources explorations), to protect water bodies and to finance administration expenses (for example: RBC).

Attention needs to be paid on the right use of fees and fee revenues should be increased as this should be used in this or that purpose etc. The current revenues should be increased till the level, which encourages users to use water wisely.

3) Water tax. This tax should be established for the purpose of supporting ecosystem services, protecting water bodies from pollution, protecting from water damages and rehabilitating them. The main organizations for establishing water tax are MNET, WA, MRTCUD, MF and local area Representatives' Khural.

The water tax needs to be local and differential. The water tax has to cover following two issues. They are:

A/ Ecosystem service: This includes water bodies and their recreation services. Differentiation will be based on locations. For example: it will be high in areas like safe ecological zones, which are close to urban areas and water bodies. It will be levied when using water bodies for the purpose of recreation and utility activities. The implementation possibility is high when calculating it within the land fee. The amount will be established in relation to the ecosystem assessment.

B/ Protecting from water damages (flood, soil water etc): This also depends on location. It will be established differently on the basis of whether land and real estate owners are protected from flood and water damages. The amount should be sufficient for the use and administration fees of water enterprise constructions dedicated to prevent from potential water threats. The implementation possibility is high when it is included in the land fee.

Usually, the capital and O&M costs for activities to protect from water threats are consuming by the state budget. In some cases, flood protection and drainage constructions are not built due to shortage of investment and vast damage occurs due to it. We cannot compensate huge amounts of socio-economic damages caused by threats from the water. But by accumulating special fees in some accumulation fund, even if it will not reach cost recovery, may protect against threats from the water. There will be a possibility to pay back after construction of the objects by issuing bonds before accumulation of some assets from the fees.

4) Water polluting fee and compensation. It is less costly to prevent than to rehabilitate already occurred damages by implementing polluter pay principle and forcing water polluters to pay for it. This is clear from international experiences. The main objectives of the fee are to keep ecological balance, to decrease negative impacts of human activities, to protect the environment and most important to prevent from threats caused by negative human activities on human health, society and economy.

Water polluters will pay this tax. Currently, users are considered as polluters. But we must recognize that all users and consumers who change the natural state of water will be considered as polluters. The example of this is: if livestock number increases, it will cause desertification and increase of surface water pollution. In other words, sustainability of natural resources will be destabilized.

The pollution fee will be levied if the pollutant level is under the standard-approved amount. Also, this fee acts as economic leverage for industries, which pollute water much, to introduce new technologies and reuse water. The fee revenue will be established in relation to activity costs to protect and prevent from pollution, to monitor pollution and administration expenses. It will be accumulated in a special fund and used for this activity. (For example: constructing WWTPs, monitoring water quality etc)

The compensation will be levied in order to erase already occurred damages. The ecological damage is very high and the amount of compensation will at least be equivalent to the expenses used for damage relief. If polluter discharges water to nature whose components have over-standard polluting particles or if polluter pollutes water bodies, fee amount will be levied in relation to its size.

5) Subsidy. Subsidy should be used wisely due to some reasons. They are: living standard of Mongolian population is low; poverty rate is high; weak financial capacity of water supply and waste water discharge organizations and high expense of water constructions. The subsidy is established in relation to state policy and expense compensation level. The following organizations will participate. They are MF, MRTCUD, MNET, WA, MFALI, the Council for regulation of the urban and settlement area water supply and sewerage use and service and local area Representatives' Khural.

Many types of taxes will probably cause psychological and economic pressures for tax payers. Advertisements and information should be done. Because understanding on water fee payment is weak. It can be managed as it will be included in other forms of taxes. It is important not to cause trouble for tax payers and to determine environmental and economic indirect influence on the basis of water related taxes and fees. The amount of water fee and taxes will be established when pay back condition is formed after financing activities using economic methods (bond, loan etc). The activities are to construct required water constructions and to protect the environment.

6.6. Financial Issues of Basin Organizations

Water resources are one of the vital issues of countries. Country's high level organizations determine water resources policy, its implementation covers many sides. Water issues should be solved in its complex way involving activities of many economic sectors and their interests. According to international experience, water resource management is implemented by water basins and it proves to have good results. So this method is being implemented in our country. At law on water, article 2, clause 19, it is specified as RBC will be established.

At the moment, some 10 RBC have been established officially and are operating. RBCs are being financed by some projects' and their financial issues should be solved immediately. River basin administrations (RBA) under RBC are planned to be established. On average, four people will work. The expense estimate for an RBA is presented in *Table 52*. If one RBA consists of 1 executive officer and 14 personnel, some MNT 134.3 million is required annually on average. This cost can be financed from revenue of water use fee. For example, recently revenue of water use in the TRB fee were MNT 160-400 million and the administrative cost of RBA will be over 50% of them.

Table 52. Administrative expenses of the River Basin Administrations

Type of expenses	Annual, MNT 000'	TOTAL 29 RBA
Number of staff, persons	15	435
TOTAL EXPENSES	134311.9	3895045.1
Salaries with Social insurance premium	80197.2	2325718.8
Salaries	72249.8	2095244.2
Social insurance premium from employer	7947.5	230477.5
Chancery, telecommunication, postage and freight	3600	104400
Transport (fuel)	9600	278400
Domestic travel	10500	304500
Utilities	5000	145000
Labor safety facilities	2500	72500
Law value and fact depreciable items	600	17400
Research, study and training	6000	174000
Payment for the others organizations work and service, fee and levies	3600	104400
Information and advertising	2500	72500
Other costs	10214.7	296226.3

Also the financial sources of RBAs can be stakeholders' donations and aid. In the future it is necessary to study possibilities to use some parts of water related taxes and fees for RBCs and RBAs. The legal environment should be created.

The above mentioned sources will be spent only for administrative expenses of RBAs. Also it is necessary to determine the financial sources for the main activities of the RBAs. They are:

- Monitoring water resources
- Developing water related infrastructures, supplying its condition to operate
- Providing possibility to have stable activities/operation of the organization

Some countries solved finances required for these activities through donation, loans and state investments. As for Mongolia, the most possible method is to solve through state budget.

Recommendations:

In Mongolia, the water fee forming structure is established in some degree and it needs to be developed in the future. There are some advantages in a water pricing mechanism: payment collecting mechanism is well established and consumers are clarity, in the level of water supply service. Also water resource use fee charges and the collection mechanism are developed at a suitable level.

The main obstacle in Mongolia is that the cost recovery level of water is not formed clearly in each stage of the water pricing system. In some cases, on the one hand, water supply service organizations face financial difficulties; on the other hand, accumulated income is not used in intended way. So, important issues to be solved firstly in the future are to renew fee forming structures of water sector, to improve coherence of fee types, to determine expense compensation level and to develop financial issues.

7. Water Infrastructure's Investment Review

7.1. Background

In the 1990s, many economic sectors collapsed, including the water sector and particularly agricultural (crops and livestock) water supply. Most irrigation systems were privatized, but functioned at a loss or owners didn't have enough capital for operation and maintenance. Some of these irrigation systems and many pastoral wells were abandoned, broke down or were plundered. In addition, investments in the water supply and sanitation systems decreased in this period with the result that most pipelines and facilities were out of order or had broke down.

Since 2000 the Mongolian economy revived and from 2005 the water infrastructure investments started to accelerate. Nevertheless, the investments still need to grow to truly recover from the neglect of and damages to water infrastructure and to cope with demands from the rapid economic and population growth.

7.1.1. Current Situation of Water sectors Investment

Water supply and sanitation

In Mongolia 80% of the water consumed is provided from groundwater. Drinking water of Mongolia is generally of good quality, and the capacity of the existing systems has been sufficient until now. However, the water quality in some aimag and soums does not meet the drinking water standard. In addition, the centralized systems' infrastructure has deteriorated significantly and there is a need for rehabilitation. Caused by the rapid growth of urban population and economy, water demand is increasing requiring new water infrastructure.

In the Millennium Development Goals (MDGs) it is aimed to increase the percentage of people that are connected to the central sanitation systems to 36.6% by 2015 and to increase the number of people that are provided with water from the central water system to 70%. Moreover, in the Master plan of Ulaanbaatar it is planned to increase the share of apartment households to 82.2% by 2020, which are to be connected to the central water supply and sanitation system.

In 2005, the Ministry of Construction and Urban Development (MCUD) has estimated the cost of achieving the MDGs for water supply and sanitation (MDG 7) by 2015 at USD 874 million. This would include investments for a new water source for Ulaanbaatar, new constructions and rehabilitation of WSS systems, wastewater treatment plants improvements and water supply and sanitation for ger areas. Achieving the 70% of the population having access to drinking water would cost about USD 80 million for kiosks connected to the central water supply system, and USD 505 million for individual connections. The World Bank estimates these costs to be even much higher. The table below compares the estimates of both the World Bank and the MCUD. Following the Parliamentary Resolution on the development of eight regional pillar cities, for water and sanitation infrastructure an estimated amount of USD 8.8 million[41] will be required.

[41] WB. Mongolia Infrastructure Report, annex 4. Water supply and sanitation

Table 53. Investment necessary for achieving MDGs 7th objective according to MCUD and WB

MDGs	MCUD	World Bank
70% of the population is provided with water from central water supply	US$ 80 million (kiosks) US$ 505 million (individual connections)	US$ 43 million / yr (kiosks)
36,6% of the population is connected to central sanitation system		US$ 358 million
Total	US$ 874 million	US$ 1.3-1.8 billion

The Action plan of "Program for great construction and mid-term goals" (which includes "Housing 100,000 Household program) aims to build about 80 thousand apartments spread over 35 locations in Ulaanbaatar and in the pillar cities and aimag centers 25 thousand household apartments along with public utilities (hospitals, schools etc.). It will support achieving the MDGs targets. [100]

Many projects that are implemented in the past few years in the apartment and urban services sector are financed from a budget coming from donor countries' aid funds and from international bank and financial organization credits. For instance, during the last 5 years, the state budget financed projects worth 60 billion MNT, in the last 10 years the international grants and credits financed about 16 projects worth more than 140 million USD. During the last 3 years the Government, initiated the construction of about 410 km water supply, sewerage pipeline and heating pipeline as well as a reservoir, wastewater treatment plant and bore wells. Under World Bank and Asian Development Bank programs about 250 km water, sewerage and heating pipelines were constructed and 7 waste water treatment plants and 30 water kiosks were connected to the pipeline. They also built about 30 water kiosks and installed water-softening equipment in 133 soums. As a result of these activities a positive development and technical renovation has taken place in this sector.

Figure 3 shows the investment trend in water supply and sanitation since 2005. From 2005 to 2008, investment in the WSS increased and reached 43.4 billion MNT.) After 2008, investment decreased and during the last two years varies between 12.6-15.1 billion MNT.

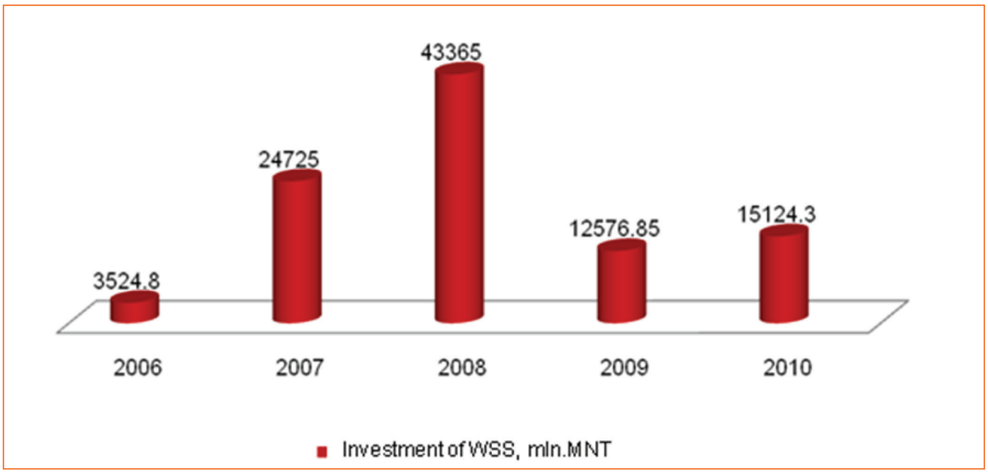

Figure 47. Water Supply and Sanitation sector's investment, Million.MNT

According to the 2011-2015 investment projections the investment will increase again.

Livestock.

The GoM's objective is to improve the water supply of pastureland, which is showing progress and investment is increasing. During 2000-2008 investments for exploration works of pasture wells stopped and because of that, sometimes wells cannot be built at its necessary place. From 2009, MAFLI started to invest again part of the government investment for water exploration works. For example in 2009, was spent 500.0 million MNT for the water exploration and defined 438 points.

The following table shows last 5 years trend of investment for wells. In 2007 was the highest government investment with 7.3 billion MNT.

Table 54. Investments in wells and boreholes, 2006-2010

Type of investment		2006	2007	2008	2009	2010
Number of new and reconstructed wells and boreholes		3658	3932	2700	2677	2635
Investment, million MNT	State budget	2204.3	7336.6	6580.6	3398.3	3552.2
	NGOs, foreign aids	2221.8	1535.9	1385.2	1610.5	2882.4
	Private	790.1	1033.8	990.2	1166.2	980.4
	Total	5216.2	9906.3	8956	6175	7415

The involvement of the private sector in investments in livestock water supply is quite high. During 2006-2010 10-18% of the Investments in wells and boreholes came from the private sector (Annex 15).

There are several programs for the improvement of pastureland. For example, in 2003 by the Government adopted the "State General Land Use Plan". In this plan, a target is mentioned to have 65 thousand hectares of pasture irrigated by 2023. To achieve this objective 10 thousand wells and boreholes have to be constructed and 17,400 wells and boreholes have to be repaired and reconstructed. A new Water program of the GoM is to construct the wells and lease them to the users (herders), which should require an annual increase of wells of 2,400 to 3,600 from 2012 to 2021. At the same time however the Water National program also approved by the State Great Khural of Mongolia states a goal of only 800 to 1000 wells to be drilled each year.

For the period 2011-2015, the GoM has projected investments for livestock water supply amounting to 26.6 billion MNT.

Irrigation

Driven by the Government food policy, investments in the agriculture water infrastructure is increasing rapidly since 2004. In 2008 the national program "Crop Rehabilitation-III" was adopted by the Government. This program aims to increase the irrigated crop area to 54,200 hectares. Within this task, it is planned to reconstruct 10,000 hectares irrigation schemes and to construct 22,000 hectares new irrigation schemes. In 2010 the above program was successfully implemented and the irrigated area reached the 37.5 thousand ha and fully satisfied the domestic needs for potatoes and 57% of the vegetable needs.

Figure 48 and *Table* 55 show the investments by various investors in irrigation from 2006 to 2010.

Table 55. Irrigation Systems Investment, in million MNT

Indicators	2006	2007	2008	2009	2010**
Irrigation schemes*	18	25	92	43	55
Area, he	4467.3	2819.7	8807	5505.3	3900
Government budget investment	1504.9	1944.2	6462.5	7393.2	5927.9
Private investment	1829.3	2536	19237.6	4983.1	6134.8
Total	3334.2	4480.2	25700.1	12376.3	12062.7

**not include small irrigation schemes*
***planned data, does not include private investment*

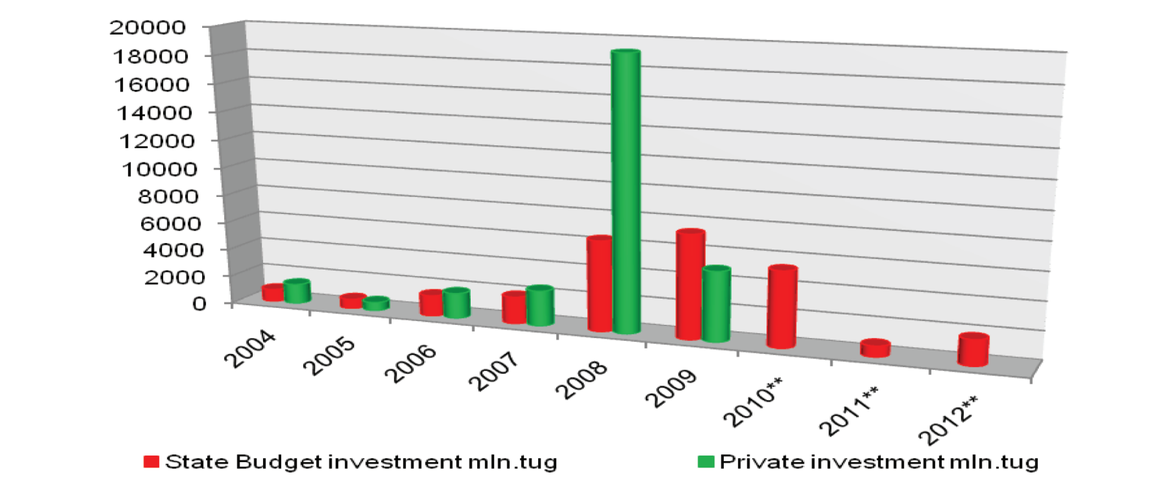

Figure 48. The irrigation systems investment, 2004-2010

In 2010, the total investment for irrigation reached 12.1 billion MNT that is more than agtripling of the investments in 2006. The government investment increased 3.9 times and private investment 3.4 times.

According to the Government budget plan of Mongolia of 2011 780 million MNT will be invested in irrigation in 2011 and 1820.0 million in 2012.

Between 2004 and 2010 60.0 billion MNT (of which 21.4 billion MNT from the state budget) was invested in irrigation, for 167 new irrigation schemes and reconstruction of 100 irrigation schemes [42].iIrrigation is the basis of a higher crop yields and satisfaction of food needs by safe and ecologically pure products.

Water Sources Protection and Water Exploration

In the 1990s, state investment in water exploration and protection of water sources had virtually collapsed. Since 2006, the Government started to pay attention again to these fields and to spend some capital. Table 53 and Figure 48 show the Government's spending on protection and exploration activities since 2006.

GoM spends every year about 200.0 million MNT for protection of springs and 300 million MNT for building ponds.

It is planned to invest 214.3 million MNT for the protection of water sources in 2011, 435.0 million MNT for the exploration and another 335.1 million MNT for the groundwater monitoring network.

Table 56. Investments in water exploration and protection, in million MNT

Indicators	2006	2007	2008	2009	2010
Protection	0.0	51.1	1057.5	217.5	222.5
Building ponds	0.0	76.7	0.0	154.0	334.7
Exploration	400.0	655.6	400.0	200.9	240.0
Monitoring network	0.0	0.0	0.0	0.0	75.0
Total	400.0	783.4	1457.5	572.4	872.2

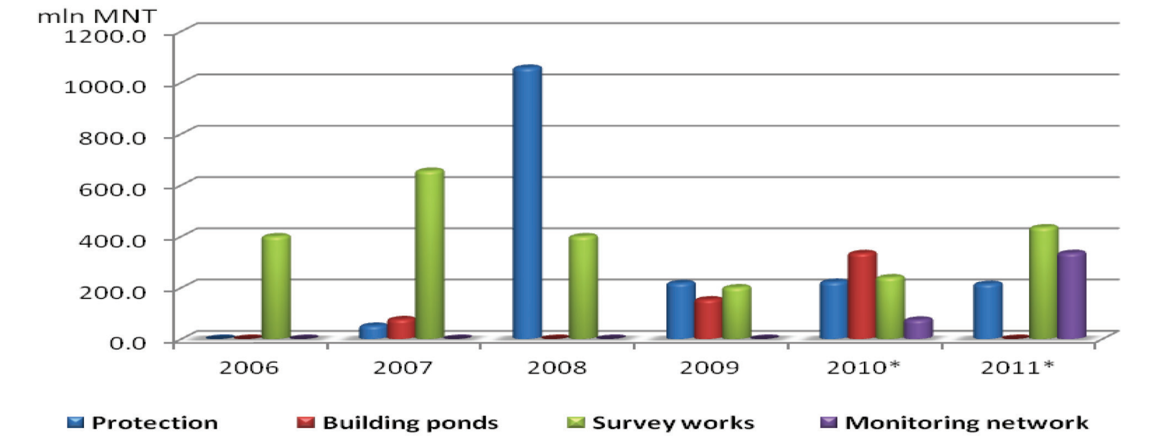

Figure 49. Investments in water exploration and protection, Million.TUG

From 2010 the government has embarked on investing in the establishment of a groundwater monitoring network. In 2010-2011 a groundwater monitoring network will be established in Ulaanbaatar, Darkhan–Uul and Baruun-Urt. It is planned to invest 1.1 Billion.MNT in 2011-2012 for hydro-geological exploration and studies for estimating the exploitable water resources.

Others

One of the other important sectors of water infrastructure is flood protection and drainage. The General Emergency Management Agency (GEMA) and MRCUD are responsible for this infrastructure. Figure 5 presents the investment trend for flood protection and drainage, showing that the investment increased in 2010 almost 20 times compared to 2005 and for 2011 it is planned to invest even more, with a total amount of 4.8 Billion.MNT.

For the flood protection of Darkhan-Uul and Bulgan aimag centers about 1.6 billion MNT was invested in 2010 and in Ulaanbaatar for drainage 0.5 billion MNT.

Another sector that was invested in is hydropower. Since 2006-2008 0.3-6.9 billion MNT was invested in this sector. The peak in 2007-2008 was caused by the construction of the Taishir and Durgun hydro power plants. In addition, a feasibility study was carried out for the Chargait and Erdeneburen hydro power plants in this period as well.

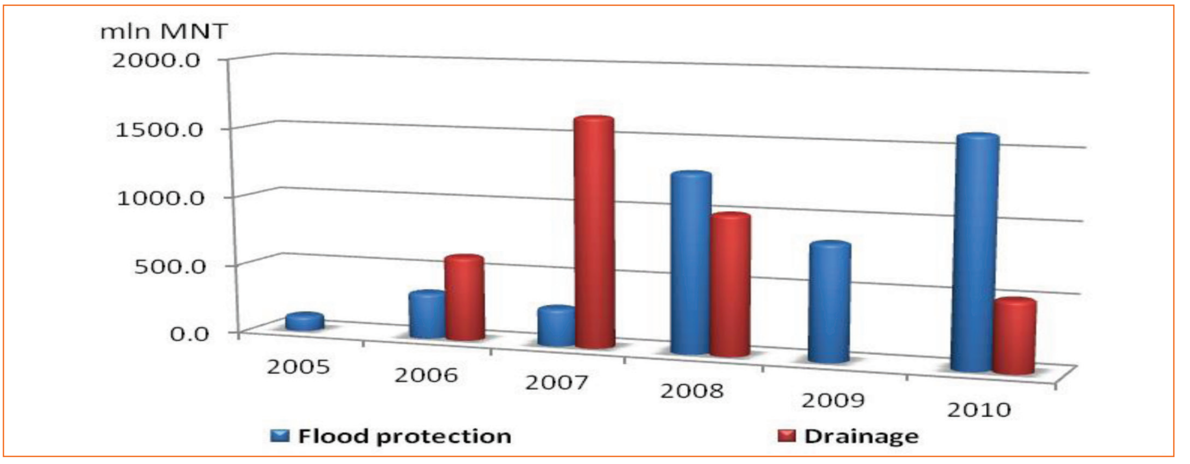

Figure 50. Investment in flood protection and drainage

A summary of these investments is given in the table below, which is limited to Government investments only.

Table 57. Investment trend in the water infrastructure, in billion MNT

Type of investment	2006	2007	2008	2009	2010
Water supply and sanitation	3.5	24.7	43.4	12.6	14.6
Agriculture	4.9	9.3	13.0	10.8	19.5
Water source protection and exploration	0.4	0.8	1.5	0.6	0.9
Flood protection and drainage	0.9	1.9	2.3	1.3	2.1
Hydro power plants	0.3	3.6	6.9	0.0	0.0
Others	0.0	0.1	1.6	0.0	0.0
Total	10.1	40.4	68.6	25.3	37.0
Total state investment of Mongolia	133.3	366.3	460.0	374.6	531.0
Share to the total	7.6%	11.0%	14.9%	6.7%	5.2%

In 2008, investment in water infrastructure reached its peak, with an amount of 68.6 billion MNT. Out of the total water infrastructure investment in 2010, 52.7% was spend in agriculture, 39.5% in the WSS sector, 5.7% for the water protection and exploration, and 2.1% for the flood protection and drainage.

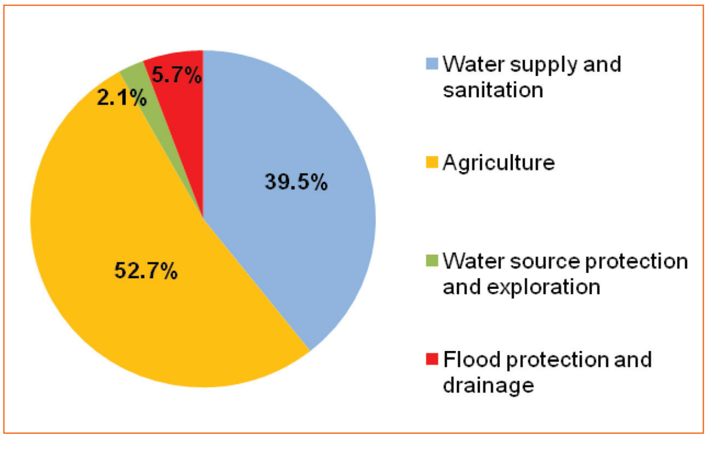

Figure 51. The Composition of the water sector investments, 2010

In 2010, the total revenue of water use fee was 4.7 billion MNT, of which 18.6% was spent for the water sources protection. This amount cannot reach to the 35% of water fee revenue, which has defined by the Law on Investment Percentage of Revenue generated from Natural Resource Usage Payments for Measures to protect environment and rehabilitate natural resources.

Foreign aid

Since 2000 international loans and grants increased rapidly after adopting the MDGs. The following projects were implemented in Mongolia:

- During the past 10 years, 16 projects worth over 140 million USD have been implemented. For example: 1999-2009 the Integrated Development of Basic Urban Services in Provincial Towns and Secondary Towns Projects was implemented in 5 aimags of the Western Region and 8 aimags of the Central and Eastern Region.
- World Vision is an international organization that operates in Mongolia and has invested 4.9 million USD between 2007 and 2010 in support of irrigation, animal husbandry and small and medium businesses. Some of the water resource management works are included in the main objectives of the risk management component of the "Sustainable livelihood-2" project's pasture animal husbandry.
- Japan, has invested 2981 million JPY since 2005 for the "Support small and medium businesses, environmental protection" project, 1685 million JPY in grants for "Water supply improvement of Ulaanbaatar" project and 983 million JPY in grants for "Water supply improvement of Darkhan" project.
- The German Government has implemented "Environment protection and sustainable environmental management" project by 11.4 million USD grants
- China has built Durgun HPP by soft loan
- The Taishir HPP was built by Kuwait soft loan.
- In 2010 was started "Peri-urban rangeland project" by Millennium Challenge Account-Mongolia. This project supports the identification of suitable leasing sites for peri-urban areas; installs wells and supplies materials for construction of fences and animal shelters; trains herder groups to improve their skills in pasture land management, herd productivity, and business and marketing etc. For the project implementation 11.8 million USD is invested, from which about 50-60% will be spent for installation of wells and supply of materials for construction of fences and animal shelters on the suitable leasing sites.

This shows that for the water sector many foreign soft loans, grants aids were invested. Furthermore, effectiveness and relationship of projects need to be improved.

In the Action plan of "New construction and mid-term development program" planned to invest 33.4% of total investment in 2011-2016 of WSS from foreign aid and soft loans. However, in 2011, Mongolia became a middle-income country, which will have an effect on foreign grants and soft loans.

7.2. Efficiency of the investment

In 2010 all the PUSOs in Mongolia operated at a loss of 1.7 billion MNT all together. The main organization of water supply – USUG operated at a profit of 6.2 billion MNT. Since then many PUSOs increased their tariffs and losses have decreased, but they still cannot recover the capital cost and have high outstanding debts. ALACGC is planning to change water tariff system of water supply organizations and implement two part tariff.

The efficiency of flood protection depends on the protected area, households, buildings etc. that are being protected. That means flood protection is more efficient in the big cities.

At present livestock watering also could not recover their capital costs. Wells, which were built or reconstructed from state budget became local property and are used under contract by herder groups. However, many cannot recover capital costs. Concerning to irrigation schemes, based on sales of crop production it is possible to recover cost. Nevertheless, according to the field trip in the Tuul river basin, the feasibility of irrigation schemes uses outdated economic analyses making it difficult to find out main financial and economic indicators. In the future, it is necessary to introduce methodologies for the economic analysis of feasibility studies of irrigation schemes. In addition, it is necessary to improve the control system of the state budget investment in agriculture because often some bad experiences of investment are observed in this sector. For example, in 2009, the "Akhmadiin sanaachlaga (10 ha)" irrigation scheme was financed in Tuv aimag, but not started yet to build. In addition, dam of reservoirs of the Guna irrigation scheme started to break down one year after construction, and has caused a critical situation.

Newly constructed and reconstructed irrigation schemes financed by state budget are registered in the MAFLI, while schemes 100% financed from private sources may not be registered. In the future, it is necessary to improve the registration system of irrigation schemes for the purpose of water use accounting and water fee. According to the field studies in TRB, private invested " Ikh ungot trade" irrigation scheme has recovered their capital cost since about two years while some irrigation schemes constructed from state budged, cost recovery period was much longer than the above scheme.

In future, cost-benefit analyses and social-economic cost benefit analyses need to be included in feasibility studies for water sector projects, and data sharing between concerned organizations needs to improve.

7.3. Further Investment Trend

According to the MDGs based Comprehensive national Development Strategy of Mongolia and other policy documents, investment in the water sector will increase and economic development and especially mining sector development will support the investment growth.

However, the water sector's planned activities in the policy documents are not identical and showed gaps, which should be analysed and revised.

On 14 December 2009, the GoM approved by 320th resolution "The List of the Initial High Priority Large Projects to be implemented by Government". This list includes four main directions with 26 large projects, of which seven will be implemented by MMRE. To realize these projects, additional exploration works of water resource will be implemented. For the infrastructure construction, some investment sources are planned to include private stakeholders.

In the 2nd main direction of the above mentioned document planned to implement "Support Development of Irrigated Crops" project, in result of which in 25.0 thousand ha irrigated area will sown wheat and 10 thousand ha-vegetables and another 5 thousand ha green forage. In the project planned to invest 50 million USD. The MAFLI estimated primarily need for irrigation development 18.1 billion MNT (about 13.4[42] million USD).[43]

42 USD 1= MNT 1350

43 Баранчулуун, ХХААХҮЯ, Усалгаатай тариалангийн хэлтэс

In the third main direction “Infrastructure development”, planned to implement “Provide water supply water needs of Gobi from Orkhon” project and estimated investment is about 540 million USD. In fourth main line planned to implement “Eco” project with 200 million USD costs for the purpose domestic and industrial sewage treatment.

In January of 2010, SGKhM approved law on Concession and in July pursued Concession list, which has include “Orkhon-Gobi”, “Tuul-Songini Complex”, CWWTP of Ulaanbaatar projects.

Moreover, in 25th of June 2010 the GoM approved by 36th resolution “Program for great construction and mid-term goals”, and after pursued the Action plan of the Program. The Action plan planned to invest in 2011-2016, 7.8% from private sector, 33.4% from foreign aids and 58.9 from state revenue from mining of total WSS investment.

According to the State budget project of 2011, the Program for great construction and mid-term goals and other policy documents, in 2011-2016 have standing to invest in totally for the WSS about 2736.8 billion MNT. According to the Action plan of national “Water” program, in 2011-2016 for the water sector development need to invest 3190.3 billion MNT. [28]

On the one hand, water sector's financing has increased and activities are about to flourish; on the other hand, water pricing structure need to be improved, and sector needs to be independent in terms of economy. It is the source for strengthening water sector, protecting water sources and using water wisely.

8. Water economic valuation

8.1. Water use benefits

The water use situation is shown by economic sector in Table 58. The water supply for population is a very important issue in Mongolia. The next important sector is agriculture, which produces 15.9 percent of GDP. This sector has a direct impact on 25.7 percent of the total households..

8.2. Water economic value

The economic assessment of water is playing an important role in the decision making of water management. There are many methods to do an economic assessment on water and in this regard, it's been described in the "Water resource assessment and economic evaluation methodology" handbook (only available in Mongolian) edited by the project. In our country, some studies in this field started to be carried out since 1980. A general assessment method for water resource or methodology to determine total water value have been described in "Ecological and economic assessment on water in Mongolia and scientific background for use, protection and restoration of water resource" (G.Dolgorsuren) in 2000 and "Methodology to calculate loss assessment of nature and environment and its compensation" approved by order A-156 by Minister of Nature and Environment in 2010.

In scope of the project, a specific market method based on 'study of readiness to process payment' has been used in making economic assessment on water resource in the Orkhon river basin. The study of readiness to process payment has been carried out by the World Bank in scope of the "The economic value of the Upper Tuul ecosystem" project. And another study has been conducted by our team in scope of this project and we came up with the same result. In making economic assessment on water resource in the future, it's very important to continuously carry out this sort of study in other basins.

The readiness to process payment means the maximum amount of money which customers are able to pay for improving environmental services and it is aimed to improve the related condition or keeping it the same instead of paying for other things by customers.

Please see the result of economic assessment on water in the Mongolian economy which was carried out based on the readiness to process payment from Figure 52.

Table 58. Water use benefits by economic sector, 2010

Water using sectors		Water pollution by type of pollutants	Water use million m³	Total output, billion TUG (at current year prices)	Employees	Beneficiaries, thousand households
Domestic		Domestic waste water and solid waste: -Dissolvable organic pollutants -Grease, oil and fat -Solid waste and soil pollutants -Hospitals: medical waste, packaging materials	60.1	42.4	7.8	742.3
Of which	CWSS system		48.2	42.4	7.8	162.7
	Connected kiosks		1.5			110.9
	By transport		1.8			160.4
	Wells and other sources		2.3			308.3
Municipalities*			5.5	956.2	148.2	106.4
Agriculture			175.6	2016.6	346.6	248.9
Of which	Livestock	Animals dung, wool, pesticides and other abstergents	76.9	1331.8	327.2	235.0
	Crop	Pesticides, herbicides and other pollutants	98.7	684.8	19.4	13.9
Industry and construction			252.7	5035.0	160.8	115.5
Of which	Mining and quarrying	Chemical and organic poising substances, heavy metals, fuel and, domestic waste	136.5	3300.3	34.8	25.0
	Construction and building materials	Building materials, Chemical poising substances painting materials, absorbers and other waste	1.2	350.8	48.8	35.0
	TEPP	Arsenic and other chemical substances	111.4	403.8	12.4	8.9
	HPP	Polluters near the water pool	~1000.0			
	Food industry	Disinfecting substances and abstergents	3.1	504.4	64.8	46.5
	Wool and cashmere	Detergent, hydrogen, chloride and other chemical substances	0.3	169.2		
	Tannery	Detergent, ammonium, sulfide sodium, chromium, aluminum, and other chemical substances	0.1	28.1		
	Others	Detergent,, abstergents and others	0.1	278.4		
Services			3.9	2720.3	368.1	264.3
Of which	Transport*	Poising gas, fuel and lubricants other waste	1.8	671.8	76.6	55.0
	Hotels and restaurants	Domestic waste water and solid waste	1.8	133.5	27.7	19.9
	Trade	Domestic waste water and solid waste	0.3	1185.7	146.2	105.0
	Other services*	Domestic waste water and solid waste		729.3	117.6	84.4
	Car washing	fuel and lubricants, crude oils and other waste				
Tourism		Domestic waste water and solid waste	0.9	79.2	2.1	1.5
Green area		Pesticides, herbicides and other pollutants	0.2		0.1	0.1
Total			501.4	8255.1	1033.7	742.3

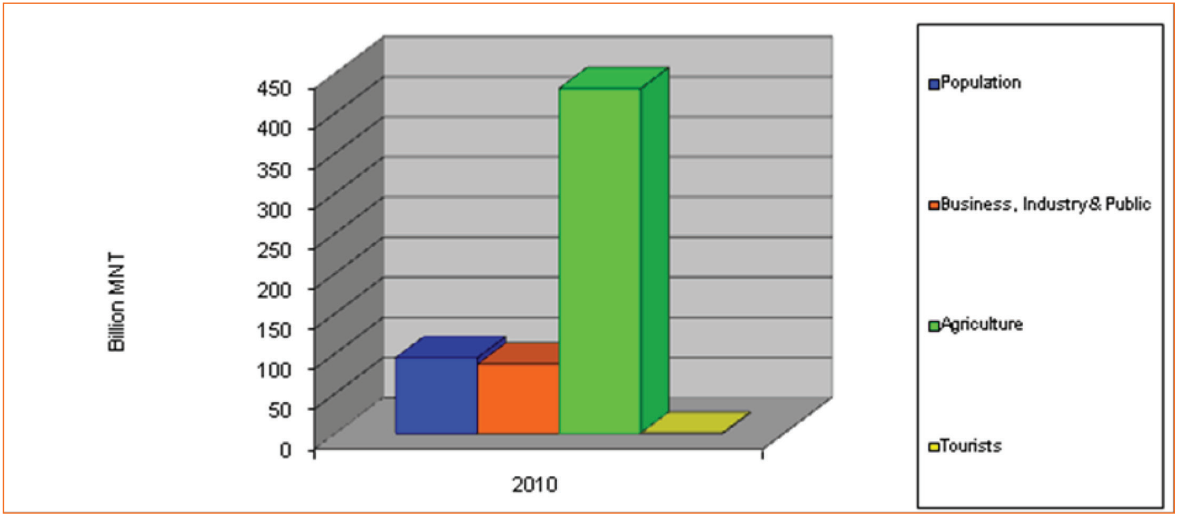

Figure 52. Water economic value by economic sector

9. Summary

The following advantages and disadvantages of social, economic and water sectors should be taken into consideration when implementing IWRM plans on the basis of current socio-economic situation. They are:

Advantages:

- High level of population education;
- Good resources of working force;
- Economic growth is high, it will be high in the long run;
- Sufficient resources of raw materials;
- Near to large markets of the world like China and Russia;
- Most of the Mongolian territory still keeps its natural form;
- Public utility sector development is in acceptable level;
- It is possible to develop it further;
- It is possible that investment increases;
- The water tariff system is formed and improvement possibility is high. The water fee collecting system is well developed in all levels;

Disadvantages:

- The number of population is few, location is scattered;
- High level of unemployment and poverty;
- The climate is extreme continental and agricultural sector is dependent on natural and climatic conditions;
- The ecosystem environment is weak, desertification is in a fast mode;
- The development of infrastructure is ill-developed;
- The economic system is uneven;
- The capacity of domestic market is small;
- The asset resource is limited;
- The investment in water sector is not adequate;
- The investment is not rational, calculation mechanism of investment result is weak;
- The work coherence of water sector steering organizations is weak;
- The water supply organizations are not able to compensate expenses and there is a high risk of loss since compensating expense level is uncertain;
- The water sector facilities are old and broken, technology is out-of-date;
- The implementation of legislation is weak;
- The payment system of water use is pretty good, but the size influence on water users is weak, spending of collected fees is uncertain, the amount used for water resources is low;
- The pollutants-pay principle was not implemented, so water pollution is high near big cities like Ulaanbaatar.

The following things should be taken into consideration when developing IWRM plans on the basis of research on current socio-economic condition of Mongolia, its development trend and water demand condition. They are:

1. The population water supply is the top-priority issue for the water sector of Mongolia. It includes:
   a. The measures which were aimed to rebuild and expand the centralized water supply and sewerage systems of urban areas (Ulaanbaatar, aimag centers, region centers) will be reflected in the IWRM plans in coherence with "Water" national program. To develop measures to be implemented between 2016 and 2021 on the basis of project basic researches;
   b. To pay attention for the improvement of water supply and sewerage facilities of herders and urban area ger districts; to plan introduction measures of small-size water supply and sewerage system which is cheap, cold-persistent and possible to be implemented in Mongolian condition; to reflect measures for increasing water demand like scaling up demand by lowering water value etc;
   c. To plan measures to adjust water quality standard for the places/organizations which do not meet the standard on the basis of water quality research.
   d. To introduce modern, new technology into the water supply and sewerage system which protects human health;
   e. To plan potential measures to change water fee-forming system in order to improve the capacity of water supply organizations, and compensating expense possibility as well as its defined level will be reflected in the management plans;
   f. To plan habituating work for water wise use of population;
2. To pay attention for the agricultural water supply, especially livestock water supply; to strengthen current success of farming, especially irrigation field; to expand in coherence with population foodstuff demand and supply.
   a. The measures to build ponds and drill wells in order to increase pasture water supply level; the measure will be reflected in the IWRM measures in coherence with state policies and programs like "Water" national program;
   b. To plan improvement measures of investment results in the pasture water supply;
   c. To plan activities for maintaining and creating irrigation field;
   d. To develop mechanisms for increasing investment benefits in the irrigation field;
   3. To pay attention for the mining sector which works as a backbone of Mongolian economic development:
   a. To plan water survey activity with the participation of investors;
   b. To develop mechanism and leverage for introducing nature-friendly technology into the mining;
   c. To develop measures to decrease water resources damage caused by the mining;
   d. To define potential scenarios which calculate results of measures, programs oriented to mining water supply;
4. To plan measures that energize water energy use, which plays a key role for decreasing global warming (to maintain and improve current hydropower plants usage);

5. Industrial water supply:
   a. To use water wisely and introduce nature-friendly technology;
   b. To pay attention to the wastewater treating activities of wool, cashmere and tannery sectors which pollute water a lot;
6. To support tourism sector development; to plan activities to introduce new technology, small-size water supply and sewerage facility;
7. To develop calculation mechanisms of investment result in the water sector and pay attention to its benefit growth; to define methods for improving work coherence among organizations which are responsible for investment;
8. To increase water resources research and improve monitoring system of water resources;
9. Due to introduction of pollutant-pay principle, damage-assessing system needs to be developed; to organize activity for developing pollutant-pay payment system;
10. To plan measure for water resources protection;
11. To improve coherence of policies and programs which are being implemented in the water sector;
12. To assess and sort socio-economic benefits of projected measures; to define potential asset sources and discuss on the investment with stakeholder organizations.

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Annexes

Annex 1. Data and information sources

№	Data type	Source	Period	Data quality
1. Water use study				
Drinking water supply				
1	Population connection to the centralized system	NSO, Local Governments, USUG, OSNAAGs, PUSOs	2004-2010	good
2	Kiosks and boreholes		2010	acceptable
3	Unprotected sources			
4	Water supply organizations	MRTCUD, ALACGC		good
2. Sewerage and WWTP				
1	Sewerage connection	MRTCUD, ALACGC, USUG, OSNAAGs, PUSOs	2010	acceptable
2	Connection to the WWTP			
3	WWTPs			
Water users and consumers main indicators				
1	Agriculture	MFALI	2004-2010	good
	Sown area		2004-2011	
	Irrigated area		2004-2012	
	Livestock	NSO, MFALI	2004-2013	
	Output		2004-2014	
	Income		2004-2015	
	Herders		2004-2016	
	Agriculture sector employees		2004-2017	
	Output of the agriculture		2004-2018	
2	Industry	NSO, Web sites of Ministries	2010	
	Capacity of the organizations			
	Employees			
3	Energy	NSO, Web sites of Ministries		
	Capacity			
	Electricity and thermal energy			
5	Mining and quarrying	NSO, Web sites of Ministries		
	Companies			
	Employees			
	Capacity			acceptable
6	Fishing	NSO, MNET		rare
	Fishing day			
7	Tourism	NSO, MFALI, MNET, web sites		
	Tourists			
	Expenditure			
	Employees			
	Capacity of the tourist camps			
8	Flood protection	MRTCUD, Local government		good
	Protected population			
	Protected organizations			
2. Social economic development				
Macroeconomic policy				

№	Data type	Source	Period	Data quality
1	Agriculture sector policy documents	Ministries, government web site, related documents	to 2011	good
2	Industrial sector policy documents			
3	Mining sector policy documents			
4	Energy sector policy documents			
5	Other sectors policy documents			
	Macroeconomic indicators			
1	Population growth	NSO, WB, ADB and others	2000-2010	good
2	livestock growth			
3	Economic growth			
4	Water tariff, its change	NSO, USUG, OSNAAG, PUSOs	2004-2010	
5	Technology	MFALI, NDIC and other ministries	2010	
6	Drinking water consumption	NSO, USUG, OSNAAG, PUSOs	2000-2010	
7	Agriculture, irrigation systems	MFALI, other ministries	2004-2010	
8	Industry			
9	Climate change	MAS, GEI	To 2011	
	Investment			
1	Water supply, sewerage	MF and other related ministries	To 2011	acceptable
2	Measures reducing pollution			rare
3	Flood protection		To 2011	acceptable
4	Drainage			rare
5	Technology renovation			
6	Water supply			acceptable
7	Other programs			rare
	3. Cost recovery of water supply			
	Water supply tariff			
1	Current price	USUG, OSNAAG, PUSOs	To 2011	good
	Tariff			
	Mechanism of pricing			
2	Aids, subsides	WB, ADB and local government		acceptable
	State and local			
	Total			
	Water supply costs			
1	Capital cost	USUG, OSNAAG, PUSOs	To 2011	acceptable
	Construction			
	Rehabilitation			
2	O&M			
3	Administrative			
	Environmental costs			
1	Tax, fee	Environmental departments	To 2011	acceptable
2	Valuation	Research reports		
	Environmental assessment			
	Evaluation/ WTP			rare
3	Protection costs	Environmental departments		acceptable
	Promotion of Water			
	4. Macroeconomic indicators			
1	GDP	NSO, web site, local Statistical Departments	2004-2010	good
2	Population			
3	Interest			
4	Unemployment			
5	Inflation			
6	Other data			

Annex 2. Population of Mongolia by region, 2008-2010

Capital and aimag	2006			2007			2008			2009			2010		
	Population, *000' people.*	urban, %	rural, %	Population, *000' people.*	urban, %	rural, %	Population, *000' people.*	urban, %	rural, %	Population *000' people.*	urban, %	rural, %	Population, *000' people.*	urban, %	rural, %
TOTAL	2 594.8	60.9	39.1	2 635.2	60.8	39.2	2 683.5	61.8	38.2	2735.8	62.6	37.4	2780.8	63.3	36.7
Western	410.0	29.2	70.8	411.1	28.1	71.9	409.1	28.6	71.4	407.9	29.2	70.8	402.7	30.3	69.7
Bayan-Olgii	100.1	30.4	69.6	100.8	29.8	70.2	101.3	31.6	68.4	101.9	32.2	67.8	100.8	34.1	65.9
Govi-Altai	60.3	31.9	68.1	60.2	30.7	69.3	59.8	29.7	70.3	59.4	29.8	70.2	58.4	32.6	67.4
Zavkhan	80.6	20.3	79.7	81.1	20.4	79.6	79.8	21.1	78.9	79.3	21.2	78.8	76.9	20.4	79.6
Uvs	80.5	28.6	71.4	80.4	27.3	72.7	79.8	28.8	71.2	78.8	29.9	70.1	78.2	30.8	69.2
Khovd	88.5	34.6	65.4	88.6	32.1	67.9	88.4	31.1	68.9	88.5	31.7	68.3	88.4	32.8	67.2
Khangai	553.8	35.2	64.8	555.7	35.8	64.2	560.6	36.1	63.9	564.9	36.3	63.7	567.1	37.4	62.6
Arkhangai	93.3	19.8	80.2	92.8	20.3	79.7	92.5	20.2	79.8	92.5	19.9	80.1	91.6	22.0	78.0
Bayankhongor	83.8	29.5	70.5	84.2	31.2	68.8	85.2	33.4	66.6	85.4	32.8	67.2	85.1	33.1	66.9
Bulgan	60.3	25.4	74.6	60.5	26.0	74.0	61.4	25	75	62.3	25.5	74.5	62.6	26.2	73.8
Orkhon	79.4	92.6	7.4	80.1	92.8	7.2	81.9	92.7	7.3	83.1	93.2	6.8	83.1	94.2	5.8
Ovorkhangai	114.9	21.2	78.8	115.7	21.7	78.3	116.6	21.6	78.4	117.5	22.3	77.7	117.4	23.0	77.0
Khovsgol	122.1	31.6	68.4	122.4	31.6	68.4	123	31.3	68.7	124.1	31.6	68.4	124.6	31.4	68.6
Central	436.5	43.1	56.9	437.9	40.4	59.6	442.6	42.8	57.2	450.6	43.1	56.9	459.1	56.9	43.1
Govisumber	12.3	61.3	38.7	12.6	60.5	39.5	12.9	60.9	39.1	13.3	61.7	38.3	13.8	62	38
Darkhan-Uul	87.5	82.1	17.9	87.6	82.6	17.4	88.2	82.1	17.9	90	81.1	18.9	91.7	81.5	18.5
Dornogovi	54.5	57.2	42.8	55.6	56.2	43.8	57.2	57.2	42.8	58.3	59.9	40.1	59.5	60.6	39.4
Dundgovi	49.2	28.0	72.0	48.8	21.0	79.0	48.2	21.4	78.6	47.7	21.4	78.6	46.3	22.5	77.5
Omnogovi	46.5	30.3	69.7	46.9	31.6	68.4	47.7	32.2	67.8	49.3	33.9	66.1	51.0	34.2	65.8
Selenge	100.1	33.2	66.8	100.5	26.9	73.1	101.6	33	67	103.5	32.4	67.6	106.6	30	70
Tov	86.4	19.2	80.8	85.9	15.8	84.2	86.8	19.7	80.3	88.5	19.9	80.1	90.2	17.4	82.6
Eastern	200.2	41.1	58.9	199.3	39.4	60.6	199.5	39.6	60.4	200.1	41.3	58.7	200.4	39.9	60.1
Dornod	73.6	53.7	46.3	72.9	53.7	46.3	73.6	51.2	48.8	73.6	53.3	46.7	73.6	54.8	45.2
Sukhbaatar	55.6	22.0	78.0	55.1	22.5	77.5	54.9	24.1	75.9	55	25.5	74.5	55.0	26.1	73.9
Khentii	71.0	43.0	57.0	71.3	37.7	62.3	71	39.7	60.3	71.5	41	59	71.8	35.1	64.9
Ulaanbaatar	994.3	100	-	1 031.2	100	-	1 071.7	100	-	1112.3	100		1151.5	100	

Annex 3. River Basins of Mongolia, population, 2010

№	River Basins	Population, thous person					Density, person/ km²
		Total	Share of the total, %	Of which			
				Capital and aimag center	Soum center	rural	
1	Selenge	72.7	2.6		55.2	17.5	2.3
2	Khuvsgul-Eg	25.0	0.9		10.5	14.5	0.6
3	Shishkhid	9.1	0.3		2.7	6.3	0.5
4	Delgermurun	58.5	2.1	36.1	3.7	18.6	2.5
5	Ider	32.2	1.2		10.1	22.1	1.4
6	Chuluut	21.5	0.8		5.0	16.5	1.1
7	Khanui	20.4	0.7		3.6	16.8	1.3
8	Orkhon	235.6	8.6	141.5	40.4	53.7	4.4
9	Tuul	1191.3	43.4	1140.7	19.9	30.6	23.9
10	Kharaa	164.1	6.0	106.5	32.5	25.0	9.4
11	Eroo	9.9	0.4		7.6	2.3	0.4
12	Onon	12.8	0.5		5.0	7.7	0.5
13	Ulz	15.1	0.5		7.2	7.9	0.4
14	Kherlen	150.4	5.5	57.6	60.9	32.0	1.4
15	Buir-Khalkh	3.0	0.1		1.8	1.2	0.1
16	Menengiin Tal	11.5	0.4		3.7	7.8	0.2
17	Umard goviin guveet-Khalhiin dundad tal	151.3	5.5	55.0	31.3	65.1	0.8
18	Galba-Uush-Doloodiin govi	49.2	1.8		26.8	22.4	0.4
19	Ongi	71.6	2.6	17.9	33.5	20.2	1.8
20	Altain Uvur Gobi	37.9	1.4		9.7	28.1	0.2
21	Taats	20.8	0.8		4.3	16.5	0.8
22	Orog-Tui	39.3	1.4	26.8	2.6	10.0	2.5
23	Buuntsagaa-Baidrag	23.1	0.8		4.4	18.7	0.7
24	Khyargas-Zavkhan	93.3	3.4	31.5	14.0	47.8	0.8
25	Khuisiin Govi-Tsetseg lake	20.5	0.7		4.9	15.6	0.5
26	Uyench-Bodonch	12.8	0.5		2.3	10.5	0.4
27	Bulgan	12.7	0.5		4.1	8.6	1.3
28	Khar Nuur-Khovd	149.5	5.4	56.2	26.7	66.6	1.7
29	Uvs Lake - Tes	66.1	2.4	22.9	13.9	29.3	1.2

Annex 4. Migration of Mongolia, 2008 and 2010

№	Aimag and capital	2008		2010	
		Departure	Arrival	Departure	Arrival
1	Arkhangai	516	2403	1077	3218
2	Bayan-Ulgii	84	780	80	2721
3	Bayankhongor	597	1046	844	2214
4	Bulgan	1060	1087	1341	1881
5	Gobi-Altai	367	1644	523	2410
6	Dornogobi	2042	1364	1777	1523
7	Dornod	441	1762	1243	2526
8	Dundgobi	240	1619	577	2594
9	Zavkhan	671	2251	1930	5473
10	Uvurkhangai	545	1650	1044	2937
11	Umnogobi	426	675	1447	589
12	Sukhbaatar	414	1417	635	1420
13	Selenge	2496	3067	4320	2911
14	Tov	2530	3623	3678	3316
15	Uvs	142	3706	1411	3367
16	Khovd	1241	2936	2562	4156
17	Khuvsgul	659	2277	1419	2864
18	Khentii	1045	2105	1381	2183
19	Darkhan-Uul	3654	4442	4367	4073
20	Ulaanbaatar	33407	10199	39701	20350
21	Orkhon	3247	3183	4102	2949
22	Gobisumber	737	666	936	720
TOTAL		56561	53902	76395	76395

Annex 5. Households by region, in thousand households

Capital and aimag	2006		2007		2008		2009		2010	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
TOTAL	372.3	260.2	381.7	264.0	408.3	269.5	440.4	276.1	463.7	278.6
Western	27.9	69.4	27.1	69.3	28.2	68.8	28.9	68.8	29.6	66.9
Bayan-Olgii	6.5	14.9	6.3	14.8	6.7	14.7	6.8	14.4	7.0	13.7
Govi-Altai	4.7	10.9	4.4	10.8	4.4	10.8	4.7	10.9	5.0	10.7
Zavkhan	4.2	16.1	4.2	16.3	4.3	16.1	4.5	16.2	4.3	15.8
Uvs	5.9	14.2	5.7	14.2	6.1	13.8	6.1	13.9	6.2	13.5
Khovd	6.6	13.3	6.5	13.2	6.7	13.4	6.8	13.4	7.1	13.2
Khangai	48.0	95.9	51.3	94.7	54.3	96.7	57.4	99.5	58.9	99.7
Arkhangai	4.6	19.9	4.7	19.7	4.9	20.1	4.9	20.7	5.5	21.0
Bayankhongor	6.0	15.1	6.3	15.3	7.3	15.1	7.6	15.4	7.8	15.4
Bulgan	3.7	11.6	3.9	11.6	3.8	12.3	4.0	12.7	4.0	12.8
Orkhon	20.4	1.6	21.0	1.6	22.1	1.6	22.8	1.6	23.0	1.4
Ovorkhangai	3.5	25.7	5.7	24.1	6.2	24.6	7.0	25.4	7.3	25.3
Khovsgol	9.8	22.0	9.7	22.4	10.0	23.0	11.1	23.7	11.3	23.8
Central	49.0	64.6	47.1	69.8	52.9	70.6	57.3	74.0	57.9	76.8
Govisumber	2.0	1.4	2.2	1.6	2.3	1.5	2.4	1.7	2.6	1.7
Darkhan-Uul	18.4	4.2	18.8	4.3	20.3	4.7	22.4	4.8	23.4	4.9
Dornogovi	8.6	6.2	8.8	6.5	9.3	6.8	10.3	6.9	10.7	7.1
Dundgovi	3.4	9.3	2.6	10.1	2.7	10.3	2.8	10.4	2.9	10.2
Omnogovi	4.0	8.7	4.3	8.9	4.8	9.5	5.4	9.9	5.6	10.5
Selenge	7.9	15.6	6.6	17.5	8.7	17.5	8.9	19.3	8.2	20.2
Tov	4.8	19.2	3.8	20.9	4.8	20.3	5.1	21.0	4.5	22.1
Eastern	20.4	30.3	21.5	30.2	21.1	33.4	23.6	33.8	22.9	35.3
Dornod	9.7	9.0	9.9	9.3	10.1	10.3	11.4	9.9	11.7	9.9
Sukhbaatar	3.0	10.5	3.1	10.6	3.7	10.9	4.1	11.1	4.3	11.2
Khentii	7.7	10.8	8.5	10.3	7.3	12.2	8.1	12.8	5.9	14.2
Ulaanbaatar	226.9	0.0	234.7	0.0	251.8	0.0	273.2	0.0	294.4	0.0

Annex 6. Number of students by region, in thousand persons, 2010-2011 academic year

Capital and aimag	Preschool education		School		High education		Vocational	
	Kindergarten	children	School	student	University and college	student	School	student
TOTAL	839	122.1	751	512.2	113	170.1	63	46.1
Western	144	17.4	152	90.3	3	3.4	7	6.3
Bayan-Olgii	29	3.7	43	23.2	1	0.1	1	1.2
Govi-Altai	28	2.8	28	12.3			1	0.9
Zavkhan	34	3.8	30	15.6			2	0.9
Uvs	26	3.4	28	19.6			1	1.8
Khovd	27	3.7	23	19.6	2	3.3	2	1.5
Khangai	172	22.1	170	114	5	1.24	10	8.2
Arkhangai	29	3.2	35	19.6	2	0.4	2	1.3
Bayankhongor	28	3	29	17.2			2	2.2
Bulgan	24	2.3	24	10.4			1	0.6
Orkhon	23	4.8	18	18.1	1	0.4	3	1.5
Ovorkhangai	31	3.5	30	22.8	1	0.4	1	1.5
Khovsgol	37	5.3	34	25.9	1	0.04	1	1.1
Central	160	19.9	155	84.6	5	2.6	16	9.5
Govisumber	7	0.9	4	3			1	0.6
Darkhan-Uul	18	3.7	28	18.5	5	2.6	4	3.5
Dornogovi	24	2.5	20	11			2	1.2
Dundgovi	20	2.3	18	8.4			1	0.8
Omnogovi	18	2	18	10.5			1	0.7
Selenge	33	4.9	35	18.9			4	1.4
Tov	40	3.6	32	14.3			3	1.3
Eastern	71	8.5	67	38.6	1	0.8	4	3.1
Dornod	23	3.2	26	14	1	0.8	2	1.5
Sukhbaatar	20	2.1	15	10.4			1	0.6
Khentii	28	3.2	26	14.2			1	1.0
Ulaanbaatar	266	50.5	206	184.6	99	162.1	26	19.0

Source: MECS

Annex 7. Human development index by aimag

Capital and aimag	2006	2007	2008	2009	2010
Country average	0.712	0.737	0.745	0.750	0.764
Western	0.668	0.689	0.705	0.698	0.702
Bayan-Olgii	0.664	0.679	0.693	0.689	0.698
Govi-Altai	0.666	0.689	0.706	0.703	0.695
Zavkhan	0.666	0.691	0.711	0.701	0.700
Uvs	0.666	0.689	0.702	0.695	0.708
Khovd	0.681	0.702	0.717	0.707	0.711
Khangai	0.704	0.742	0.741	0.740	0.749
Arkhangai	0.674	0.699	0.718	0.724	0.722
Bayankhongor	0.657	0.673	0.692	0.692	0.693
Bulgan	0.692	0.711	0.730	0.735	0.739
Orkhon	0.801	0.842	0.831	0.825	0.845
Ovorkhangai	0.660	0.677	0.689	0.696	0.694
Khovsgol	0.640	0.663	0.681	0.681	0.685
Central	0.690	0.710	0.726	0.731	0.745
Govisumber	0.721	0.703	0.747	0.742	0.773
Darkhan-Uul	0.691	0.703	0.721	0.725	0.739
Dornogovi	0.666	0.657	0.686	0.689	0.692
Dundgovi	0.694	0.695	0.710	0.711	0.715
Omnogovi	0.699	0.736	0.744	0.761	0.774
Selenge	0.687	0.731	0.742	0.738	0.750
Tov	0.684	0.699	0.718	0.729	0.739
Eastern	0.672	0.707	0.703	0.706	0.709
Dornod	0.642	0.662	0.672	0.677	0.682
Sukhbaatar	0.694	0.755	0.733	0.735	0.734
Khentii	0.680	0.690	0.703	0.703	0.710
Ulaanbaatar	0.739	0.755	0.764	0.774	0.790

Source: Statistical yearbook of Mongolia-2010

Annex 8. GDP at current prices

Aimag capital	2006				2007				2008				2009				2010			
	GDP, Billion MNT	Share to total, %			GDP, Billion MNT	Share to total, %			GDP, Billion MNT	Share to total, %			GDP, Billion MNT	Share to total, %			GDP, Billion MNT	Share to total, %		
		Agriculture	Industry and construction	Service		Agriculture	Industry and construction	Service		Agriculture	Industry and construction	Service		Agriculture	Industry and construction	Service		Agriculture	Industry and construction	Service
TOTAL	3 715.0	19.5	40.4	40.1	4 956.7	18.4	40.7	40.9	6 555.6	19.2	33.6	47.2	6 590.6	17.9	32.5	49.6	8 255.0	15.9	35.6	48.5
Western	269.6	71.8	4.4	23.8	342.5	72.6	3.0	24.4	480.6	64.0	1.8	34.2	377.1	63.1	1.8	35.1	389.0	58.4	5.2	36.4
Bayan-Olgii	49.5	58.6	4.8	36.6	60.4	60.0	3.5	36.5	84.7	51.2	4.4	44.4	69.9	49.5	5.2	45.3	77.7	47.0	5.9	47.1
Govi-Altai	46.1	72.9	3.5	23.7	55.7	76.8	1.7	21.5	75.0	67.9	-2.8	34.9	62.8	65.1	-2.9	37.8	58.3	55.6	1.0	43.4
Zavkhan	56.3	75.2	3.8	21.0	74.4	75.1	3.1	21.8	112.0	68.3	-1.6	33.3	82.1	71.5	-3.1	31.6	77.3	65.4	0.5	34.1
Uvs	54.5	72.5	4.7	22.7	71.1	72.0	5.7	22.3	93.2	61.4	3.2	35.4	75.9	56.9	7.3	35.8	84.0	55.9	11.3	32.8
Khovd	63.3	77.7	4.9	17.4	80.9	77.2	3.5	19.3	115.8	68.9	5.1	26.0	86.4	70.1	2.3	27.6	91.7	66.5	5.8	27.7
Khangai	987.8	24.9	66.1	8.9	1 338.8	24.5	66.4	9.1	1 475.0	31.9	52.6	15.5	1 299.0	34.0	48.0	18.0	1 496.1	30.7	53.9	15.4
Arkhangai	69.2	83.3	1.2	15.4	93.9	82.8	1.5	15.7	147.3	77.4	1.4	21.2	142.7	77.7	1.2	21.1	141.3	77.6	1.6	20.8
Bayankhongor	49.3	67.9	8.9	23.2	63.2	70.0	4.5	25.5	103.7	58.1	8.5	33.4	89.3	55.3	6.6	38.1	91.7	54.6	8.9	36.5
Bulgan	50.9	79.1	2.4	18.5	67.0	79.2	1.8	19.0	108.4	76.5	1.6	21.9	112.4	75.9	2.3	21.8	121.2	78.7	1.8	19.5
Orkhon	673.5	0.9	95.4	3.7	919.6	0.9	95.5	3.6	828.1	1.6	91.2	7.2	678.7	2.0	89.3	8.7	862.7	1.8	91.3	6.9
Ovorkhangai	64.6	71.3	4.8	23.9	84.3	71.2	3.1	25.7	116.8	65.8	3.5	30.7	121.0	58.6	3.2	38.2	118.8	60.3	2.3	37.4
Khovsgol	80.1	78.2	1.5	20.3	110.8	76.4	2.1	21.5	170.6	71.9	2.5	25.6	154.8	71.7	2.7	25.6	160.4	73.0	2.8	24.2
Central	377.8	46.2	29.4	24.3	468.1	44.4	32.9	22.7	725.2	45.1	25.9	29.0	736.1	47.6	25.4	27.0	915.1	48.4	28.6	23.0
Govisumber	11.1	29.2	49.0	21.8	8.3	40.4	17.1	42.5	19.5	18.8	41.5	39.7	18.5	17.0	53.3	29.7	28.6	13.3	67.1	19.6
Darkhan-Uul	57.8	17.6	42.9	39.6	82.7	16.1	47.7	36.2	135.4	18.7	37.0	44.3	127.4	21.7	35.9	42.4	155.0	21.2	43.0	35.8
Dornogovi	22.3	48.6	7.5	43.9	27.8	44.3	6.0	49.7	53.3	41.5	4.3	54.2	55.1	44.6	4.4	51.0	61.1	49.3	5.0	45.7
Dundgovi	39.2	75.4	4.2	20.4	42.7	74.1	3.1	22.8	58.9	64.1	1.9	34.0	53.2	67.4	1.9	30.7	54.3	67.3	2.9	29.8
Omnogovi	71.3	27.4	46.3	26.3	83.0	28.7	58.4	12.9	110.5	33.8	47.6	18.6	141.7	25.1	56.5	18.4	182.4	17.2	66.3	16.5
Selenge	100.7	44.7	40.1	15.2	132.4	40.6	44.2	15.2	208.4	48.9	32.6	18.5	189.2	57.4	22.8	19.8	251.6	65.1	18.2	16.7
Tov	75.3	74.8	5.6	19.6	91.2	76.5	3.3	20.2	139.3	70.9	4.3	24.8	151.0	75.9	2.9	21.2	182.1	79.2	2.3	18.5
Eastern	223.5	42.0	44.8	13.2	271.5	41.1	43.4	15.5	279.9	47.0	24.5	28.5	264.5	46.7	26.7	26.6	280.8	52.7	20.8	26.5
Dornod	40.9	59.6	11.7	28.7	60.2	50.4	21.2	28.4	80.9	52.9	11.8	35.3	77.4	50.5	7.9	41.6	82.4	50.5	11.8	37.7
Sukhbaatar	132.7	23.4	70.6	6.0	149.9	23.8	69.1	7.1	116.3	31.8	48.7	19.5	111.7	30.4	55.5	14.1	111.5	42.2	39.5	18.3
Khentii	49.9	77.2	3.4	19.4	61.5	74.2	2.6	23.2	82.8	62.7	2.8	34.5	75.3	66.9	3.3	29.8	86.9	68.1	5.4	26.5
Ulaanbaatar	1 856.3	0.8	33.6	65.6	2 535.8	0.7	33.4	65.9	3 594.9	0.7	32.3	67.0	3 913.9	0.7	32.0	67.3	5 174.1	0.7	34.6	64.7

Annex 9. Herders and herders' families by aimag, in thousand people and thousand households

Capital and aimag	2006		2007		2008		2009		2010	
TOTAL	364.4	170.8	366.2	171.6	360.3	171.1	349.3	170.1	327.2	160.3
Western	108.8	49.3	108.7	49.8	105.1	48.1	100.4	46.8	88.2	42.8
Bayan-Olgii	23.1	11.1	23.7	11.1	22.9	9.7	21.1	10.4	18.7	9.4
Govi-Altai	19.1	8.4	17.9	8.4	17.2	8.2	16.4	8.0	14.8	7.2
Zavkhan	23.4	10.5	23.7	10.8	22.6	10.8	21.7	10.1	17.8	8.7
Uvs	21.2	10.1	21.9	10.1	20.6	9.9	19.6	9.4	18.9	9.0
Khovd	22.0	9.3	21.4	9.4	21.8	9.4	21.6	8.9	18.0	8.5
Khangai	143.8	68.8	146.2	69.3	145.7	70.0	141.6	69.7	135.0	67.2
Arkhangai	32.3	16.3	32.9	16.1	34.6	15.9	31.3	15.7	30.2	15.8
Bayankhongor	24.3	11.6	24.3	11.6	24.0	11.6	23.7	11.6	22.3	11.1
Bulgan	13.5	6.6	15.1	7.4	14.5	7.7	15.5	7.8	15.3	7.5
Orkhon	1.7	0.9	1.9	0.9	2.3	1.3	2.1	1.0	2.4	1.3
Ovorkhangai	35.0	16.6	33.6	16.6	34.0	17.0	32.8	16.9	30.8	15.5
Khovsgol	37.1	16.8	38.4	16.7	36.3	16.5	36.3	16.7	34.0	16.1
Central	63.1	30.7	64.3	31.2	64.0	31.8	63.9	32.6	61.6	30.6
Govisumber	1.2	0.6	1.0	0.5	0.9	0.5	0.8	0.5	0.9	0.4
Darkhan-Uul	2.0	1.1	2.2	1.0	2.5	1.1	2.8	1.3	3.2	1.2
Dornogovi	7.3	3.5	7.2	3.4	6.9	3.3	6.8	3.4	6.8	3.4
Dundgovi	16.5	7.7	15.9	7.6	15.3	7.5	14.5	7.1	12.4	6.2
Omnogovi	12.1	6.2	12.3	6.3	11.9	6.4	11.6	6.3	10.3	5.6
Selenge	7.0	3.1	6.7	3.2	7.6	3.8	9.1	4.3	8.9	4.2
Tov	16.9	8.5	18.9	9.3	18.9	9.2	18.3	9.7	19.1	9.5
Eastern	42.5	19.0	40.6	18.6	39.4	18.8	38.0	18.3	37.1	18.0
Dornod	9.8	4.6	9.1	4.4	9.2	4.6	8.5	4.4	8.3	4.1
Sukhbaatar	18.3	7.4	17.0	6.9	15.7	6.7	16.0	7.1	15.1	6.9
Khentii	14.4	7.1	14.5	7.3	14.5	7.4	13.5	6.8	13.7	7.0
Ulaanbaatar	6.1	3.0	6.4	2.6	6.1	2.5	5.4	2.7	5.3	1.7

Annex 10. Livestock by aimag, in thousand head, 2010

Capital and aimag	Total	Camel	Horse	Cattle	sheep	Goat	In sheep head
TOTAL	32 729.5	269.6	1 920.30	2 176.00	14 480.40	13 883.20	54 821.4
Western	7 418.5	64.8	300	323.5	3 086.30	3 643.90	10 519.1
Bayan-Olgii	1 126.9	3.8	43.5	66	459.8	553.8	1 660.5
Govi-Altai	1 315.5	24.3	38.8	18.4	396.2	837.8	1 618.8
Zavkhan	1 717.7	5.8	93.4	73.7	859.1	685.7	2 493.9
Uvs	1 619.3	14.5	59.7	84.4	776.9	683.8	2 368.6
Khovd	1 639.1	16.3	64.7	81	594.2	882.9	2 377.1
Khangai	12 216.5	49	726.5	985.9	5 384.70	5 070.30	20 775.8
Arkhangai	2 679.2	0.9	196.1	302	1 327.50	852.8	5 194.9
Bayankhongor	1 963.0	30.1	74.4	101.5	543.8	1 213.30	2 898.9
Bulgan	2 293.2	0.9	182.8	176.1	1 179.80	753.6	4 010.1
Orkhon	169.2	0.2	10.7	17.8	73.1	67.4	313.1
Ovorkhangai	2 010.6	14.7	113.8	76.2	896.6	909.2	2 905.5
Khovsgol	3 101.3	2.3	148.7	312.4	1 363.90	1 274.00	5 454.6
Central	7 558.0	135	445	418.2	3 327.50	3 232.20	12 198.9
Govisumber	153.2	0.5	6.9	3.7	65.2	76.9	197.8
Darkhan-Uul	249.8	0.7	10.2	32.5	127.6	78.8	481.2
Dornogovi	1 056.8	28.1	77.4	40.4	421.3	489.6	1 700.3
Dundgovi	1 111.5	18.9	51.3	18.6	529.7	493.1	1 473.6
Omnogovi	1 010.3	83.8	37.6	7.5	212.8	668.6	1 557.8
Selenge	1 265.6	0.8	61.8	143.5	612.2	447.4	2 333.2
Tov	2 710.7	2.2	199.8	172	1 358.70	977.9	4 455.0
Eastern	5 273.8	20.5	428.1	393.5	2 580.30	1 851.40	9 264.6
Dornod	1 113.3	6	136.3	107.8	550.8	312.4	2 304.1
Sukhbaatar	1 979.8	10.9	148.1	128	961.2	731.7	3 321.6
Khentii	2 180.7	3.7	143.7	157.7	1 068.30	807.3	3 639.5
Ulaanbaatar	262.9	0.2	20.8	54.9	101.6	85.4	668.0

Annex 11. Livestock by River Basin, in thousand head, 2010

No	River Basin	Total		Camel	Horse	Cattle	Sheep	Goat
		number	Share to total, %					
1	Selenge	1196.0	3.7	0.1	57.4	118.4	548.8	471.3
2	Khuvsgul-Eg	621.7	1.9	0.1	37.0	119.8	226.6	238.2
3	Shishkhid	188.4	0.6	0.2	14.2	40.4	71.9	61.7
4	Delgermurun	1135.7	3.5	1.2	47.5	83.6	530.1	473.4
5	Ider	785.1	2.4	0.3	46.2	57.4	390.6	290.6
6	Chuluut	680.2	2.1	0.0	43.6	123.0	306.5	207.2
7	Khanui	981.3	3.0	0.1	76.6	87.2	535.2	282.2
8	Tuul	2870.0	8.8	1.8	221.9	254.1	1377.9	1014.3
9	Orkhon	2853.2	8.7	2.2	201.9	167.6	1466.1	1015.5
10	Kharaa	1020.0	3.1	0.9	59.5	135.0	483.7	340.9
11	Eroo	215.7	0.7	0.1	8.8	27.1	103.9	75.8
12	Onon	491.5	1.5	0.5	36.5	67.6	217.0	169.9
13	Ulz	477.8	1.5	1.6	49.8	43.5	244.1	138.8
14	Kherlen	2736.4	8.4	8.0	216.1	168.5	1382.5	961.4
15	Buir-Khalkh	55.3	0.2	0.4	7.3	11.3	23.2	13.1
16	Menengiin Tal	449.3	1.4	2.7	52.4	44.0	192.4	157.8
17	Umard goviin guveet-Khalhiin dundad tal	3608.3	11.0	36.1	218.8	122.9	1758.4	1472.1
18	Galba-Uush-Doloodiin govi	1390.4	4.2	58.9	92.4	64.2	543.2	631.7
19	Ongi	604.1	1.8	25.0	33.3	19.6	236.1	290.0
20	Altain Uvur Gobi	1294.1	4.0	53.2	27.4	8.0	213.3	992.2
21	Taats	643.7	2.0	7.8	25.7	19.1	235.8	355.3
22	Orog-Tui	521.3	1.6	5.1	19.8	41.6	133.7	321.1
23	Buuntsagaan-Baidrag	819.5	2.5	4.3	36.1	42.8	259.2	477.1
24	Khyargas-Zavkhan	2155.5	6.6	18.8	94.3	62.3	963.0	1017.1
25	Khuisiin Govi-Tsetseg lake	732.8	2.2	13.2	28.1	19.1	271.4	401.0
26	Uyench-Bodonch	310.0	0.9	3.3	13.1	15.8	111.3	166.5
27	Bulgan	146.6	0.4	1.5	6.7	11.8	35.6	90.9
28	Khar Nuur-Khovd	2392.5	7.3	15.8	89.2	120.9	925.2	1241.3
29	Uvs Lake - Tes	1353.1	4.1	6.4	58.9	79.3	693.6	514.9
	TOTAL	32729.5	100.0	269.6	1920.3	2176.0	14480.4	13883.2

Annex 12. Livestock by River Basin, in term of sheephead, 2010

No	River Basin	Livestock		In sheephead		
		number, 000'head	Share to total, %	number, 000'head	Share to total, %	On 100 hectare
1	Selenge	1196.0	3.7	2085.8	3.8	134
2	Khuvsgul-Eg	621.7	1.9	1419.3	2.6	91
3	Shishkhid	188.4	0.6	470.6	0.9	41
4	Delgermurun	1135.7	3.5	1795.9	3.3	98
5	Ider	785.1	2.4	1321.5	2.4	80
6	Chuluut	680.2	2.1	1536.0	2.8	94
7	Khanui	981.3	3.0	1849.1	3.4	145
8	Tuul	2870.0	8.8	5377.5	9.8	126
9	Orkhon	2853.2	8.7	4809.6	8.8	114
10	Kharaa	1020.0	3.1	2021.5	3.7	196
11	Eroo	215.7	0.7	396.6	0.7	116
12	Onon	491.5	1.5	1033.3	1.9	66
13	Ulz	477.8	1.5	986.6	1.8	29
14	Kherlen	2736.4	8.4	4811.5	8.8	50
15	Buir-Khalkh	55.3	0.2	155.8	0.3	7
16	Menengiin Tal	449.3	1.4	979.0	1.8	19
17	Umard goviin guveet-Khalhiin dundad tal	3608.3	11.0	5532.5	10.1	31
18	Galba-Uush-Doloodiin govi	1390.4	4.2	2438.0	4.4	18
19	Ongi	604.1	1.8	972.8	1.8	25
20	Altain Uvur Gobi	1294.1	4.0	1612.0	2.9	9
21	Taats	643.7	2.0	889.0	1.6	35
22	Orog-Tui	521.3	1.6	836.6	1.5	54
23	Buuntsagaan-Baidrag	819.5	2.5	1219.7	2.2	35
24	Khyargas-Zavkhan	2155.5	6.6	3006.1	5.5	27
25	Khuisiin Govi-Tsetseg lake	732.8	2.2	1009.4	1.8	26
26	Uyench-Bodonch	310.0	0.9	464.3	0.8	17
27	Bulgan	146.6	0.4	243.0	0.4	25
28	Khar Nuur-Khovd	2392.5	7.3	3471.4	6.3	42
29	Uvs Lake - Tes	1353.1	4.1	2077.1	3.8	46
	TOTAL	32729.5	100.0	54821.6	100.0	49

Annex 13. Pastureland and access to pasture, by aimag

Aimag capital	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
	Pastureland area (000'he)					In term of sheephead on 100 he pasture				
TOTAL	113550.4	113502.8	113308.3	113052.3	112970.5	51	57	60	61	49
Western	28 990.1	28 982.2	28 907.7	28 901.1	28889.1	53	60	59	53	37
Bayan-Olgii	3 466.5	3 596.8	3 596.5	3 596.5	3593.8	64	67	62	53	47
Govi-Altai	8 820.9	8 820.2	8 815.7	8 815.4	8813.4	31	35	35	31	19
Zavkhan	6 994.1	6 994.1	6 926.2	6 925.4	6925.3	54	63	66	60	38
Uvs	4 501.8	4 364.4	4 362.4	4 362.3	4359.2	77	86	81	75	55
Khovd	5 206.8	5 206.7	5 206.9	5 201.5	5197.4	63	70	67	61	46
Khangai	25 627.1	25 624.1	25 614.8	25 529.0	25443.9	80	92	102	108	83
Arkhangai	3 793.4	3 793.0	3 793.0	3 793.0	3792.9	134	151	170	183	139
Bayankhongor	8 977.7	8 976.9	8 976.1	8 888.2	8879.0	32	37	42	43	33
Bulgan	2 633.0	2 632.9	2 632.4	2 632.2	2602.4	117	136	160	173	161
Orkhon	41.1	41.1	41.1	41.1	41.0	729	865	1048	1030	771
Ovorkhangai	5 746.2	5 746.2	5746.0	5745.7	5700.4	70	84	88	93	53
Khovsgol	4 435.7	4 434.0	4426.2	4428.8	4428.2	117	131	142	147	123
Central	35 875.3	35 851.7	35 748.6	35 721.5	35705.2	32	37	41	45	35
Govisumber	538.1	536.7	482.0	481.7	481.1	48	51	47	46	43
Darkhan-Uul	198.1	194.2	194.0	193.2	188.7	165	206	288	313	248
Dornogovi	9 291.6	9 288.5	9 282.4	9 282.0	9273.5	14	15	17	19	19
Dundgovi	7 167.3	7 166.4	7166.1	7165.9	7164.7	38	41	38	39	21
Omnogovi	11 467.8	11 467.3	11 463.9	11 456.0	11465.7	14	17	20	21	13
Selenge	1 771.5	1 764.1	1 761.3	1 759.8	1758.1	79	101	136	148	132
Tov	5 440.9	5 434.5	5 398.9	5 382.9	5373.5	72	85	93	106	87
Eastern	22 788.7	22 779.2	22 775.7	22 644.7	22680.8	42	44	41	43	43
Dornod	9 740.2	9 737.1	9 735.1	9 606.2	9560.7	25	28	30	30	26
Sukhbaatar	7 638.7	7 638.0	7 637.7	7 636.0	7718.1	44	43	36	41	45
Khentii	5 409.8	5 404.1	5 402.9	5 402.5	5402.0	69	75	69	71	70
Ulaanbaatar	269.2	265.6	261.5	256.0	251.5	261	273	297	319	260

Annex 14. New and reconstructed wells by aimag

Aimag, capital	Number of new wells					Of which Deep wells					Reconstructed wells					Of which Deep wells				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
TOTAL	345	916	724	505	0	345	916	724	505	0	934	633	324	217	0	934	633	324	217	0
Western	58	152	115	97	0	58	152	115	97	0	187	125	80	38	0	187	125	80	38	0
Bayan-Olgii	3	0	9	7		3	0	9	7		14	5	7	3		14	5	7	3	
Govi-Altai	9	39	13	21		9	39	13	21		48	33	14	14		48	33	14	14	
Zavkhan	8	35	28	20		8	35	28	20		58	26	18	4		58	26	18	4	
Uvs	23	50	33	32		23	50	33	32		28	28	22	15		28	28	22	15	
Khovd	15	28	32	17		15	28	32	17		39	33	19	2		39	33	19	2	
Khangai	69	244	212	122	0	69	244	212	122	0	254	159	72	64	0	254	159	72	64	0
Arkhangai	11	32	84	29		11	32	84	29		59	48	17	20		59	48	17	20	
Bayankhongor	13	29	27	20		13	29	27	20		29	22	10	8		29	22	10	8	
Bulgan	11	72	48	42		11	72	48	42		57	26	18	9		57	26	18	9	
Orkhon	5	23	8	2		5	23	8	2		48	0	0	5		48		0	5	
Ovorkhangai	20	39	34	15		20	39	34	15		57	27	20	8		57	27	20	8	
Khovsgol	9	49	11	14		9	49	11	14		4	36	7	14		4	36	7	14	
Central	142	274	234	181	0	142	274	234	181	0	285	180	115	54	0	285	180	115	54	0
Govisumber	6	0	4	2		6		4	2		9	4	4	3		9	4	4	3	
Darkhan-Uul	10	31	17	1		10	31	17	1		65	13	0	3		65	13	0	3	
Dornogovi	15	53	30	21		15	53	30	21		51	35	26	4		51	35	26	4	
Dundgovi	16	44	27	17		16	44	27	17		48	44	8	2		48	44	8	2	
Omnogovi	13	54	26	13		13	54	26	13		13	21	13	7		13	21	13	7	
Selenge	24	24	38	17		24	24	38	17		17	24	18	19		17	24	18	19	
Tov	58	68	92	110		58	68	92	110		82	39	46	16		82	39	46	16	
Eastern	58	193	142	78	0	58	193	142	78	0	201	162	55	57	0	201	162	55	57	0
Dornod	21	59	25	28		21	59	25	28		69	68	18	15		69	68	18	15	
Sukhbaatar	18	58	44	28		18	58	44	28		49	33	11	8		49	33	11	8	
Khentii	19	76	73	22		19	76	73	22		83	61	26	34		83	61	26	34	
Ulaanbaatar	18	53	21	27		18	53	21	27		7	7	2	4		7	7	2	4	

Annex 15. Investment, in million MNT

A. Investment in new wells, in million MNT

Aimag, capital	Total investment					State budget					Foreign aids, NGOs					Private				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
TOTAL	2674.0	7539.8	7614.7	5579.6	6319.2	1060.1	5856.9	5600.5	3262.7	3353.2	1071.4	1082.2	1274.9	1454.6	2232.7	542.5	600.7	739.3	862.4	733.0
Western	389.1	1568.8	1305.5	998.6	1153.2	222.3	1484.9	1229.8	806.1	769.1	98.5	14.3	30.0	108.4	325.0	68.2	69.6	45.7	84.1	59.1
Bayan-Olgii	24.4	230.3	88.1	92.2	83.6	22.4	227.1	81.1	49.1	78.7	1.4	0.1	-	15.9	0.0	0.6	3.1	7.0	27.1	4.9
Govi-Altai	91.8	218.7	114.2	108.6	220.9	53.6	197.2	103.5	83.1	83.0	27.4	1.5	-	14.3	129.8	10.8	20.0	10.7	11.3	8.1
Zavkhan	74.8	423.3	375.0	281.2	195.3	71.0	400.9	368.7	259.6	187.5	0.5	12.7	-	13.8	4.9	3.3	9.7	6.3	7.7	2.9
Uvs	112.8	469.1	384.7	333.9	357.4	29.8	463.5	346.9	239.9	246.8	40.6	-	30.0	64.4	92.8	42.4	5.6	7.8	29.6	17.8
Khovd	85.3	227.4	343.5	182.8	296.0	45.6	196.2	329.6	174.3	173.1	28.7	-	-	-	97.5	11.0	31.2	13.9	8.4	25.4
Khangai	619.2	1989.2	2340.1	1390.4	2183.2	251.3	1354.8	1650.5	640.2	930.6	307.1	530.8	601.2	553.7	1085.1	60.8	103.6	88.4	196.4	167.5
Arkhangai	101.7	314.7	1003.2	296.1	571.9	68.5	134.7	704.6	145.0	472.9	26.3	176.4	296.6	135.5	75.6	6.9	3.6	2.0	15.6	23.4
Bayankhongor	88.4	200.9	245.8	332.5	111.0	15.2	148.3	217.8	265.6	76.1	63.3	30.0	6.0	34.2	16.4	9.8	22.6	22.0	32.7	18.5
Bulgan	96.1	589.8	533.6	352.4	605.0	49.9	372.5	281.0	86.5	211.5	28.7	195.3	238.8	253.0	365.1	17.6	22.0	13.8	12.9	28.4
Orkhon	39.7	159.5	79.9	21.0	32.0	32.0	114.5	79.9	-	0.0	0.0	45.0	-	-91.8	32.0	7.7	-	-	21.0	
Ovorkhangai	260.7	322.7	312.2	201.0	698.6	53.2	238.8	215.5	26.3	58.3	188.8	40.0	47.8	76.8	549.9	18.6	43.9	48.9	98.0	90.4
Khovsgol	32.7	401.6	165.4	187.4	165.0	32.5	346.0	151.7	116.8	111.8	0.0	44.1	12.0	54.3	46.2	0.2	11.5	1.7	16.3	7.0
Central	1145.6	2286.7	2259.9	2021.9	2217.1	395.7	1842.8	1600.4	1264.3	1159.8	468.9	241.5	229.0	412.3	652.1	281.0	202.4	430.5	345.3	405.1
Govisumber	45.7	1.2	18.0	6.9	76.4	42.7	-	16.5	5.3	55.9	0.0	-	-	-	20.4	3.0	1.2	1.5	1.6	0.1
Darkhan-Uul	187.7	2.9	187.0	10.0	30.0	56.2	2.8	187.0	-	30.0	120.9	-	-	-		10.6	0.1	-	10.0	
Dornogovi	168.7	750.0	275.0	337.5	272.5	92.2	735.0	259.0	157.8	159.4	61.2	2.5	1.0	156.5	78.0	15.3	12.5	15.0	23.2	35.1
Dundgovi	99.7	374.4	264.8	245.1	242.6	84.1	360.5	206.9	237.9	208.5	1.7	-	21.6	-	24.1	13.9	13.9	36.3	7.2	10.0
Omnogovi	100.0	495.9	319.1	234.8	424.5	40.0	352.4	250.8	133.3	224.6	60.0	115.0	11.9	66.8	145.1	0.0	28.5	56.4	34.6	54.8
Selenge	176.4	112.7	318.5	8.3	370.1	38.0	50.2	192.5	8.3	81.0	83.6	24.6	19.0	-	148.3	54.9	37.9	107.0	-	140.8
Tov	367.4	549.6	877.5	1179.3	800.9	42.6	341.9	487.7	721.7	400.4	141.5	99.4	175.5	189.0	236.2	183.3	108.3	214.3	268.6	164.3
Eastern	341.5	1406.7	1374.0	828.3	738.2	157.6	1124.7	957.6	487.9	481.7	118.6	116.6	249.2	237.3	170.5	65.3	165.4	167.2	103.2	85.8
Dornod	116.3	403.0	298.4	243.9	173.3	92.6	348.7	206.9	173.5	143.1	13.1	8.6	48.0	39.6	19.0	10.6	45.7	43.5	30.9	11.2
Sukhbaatar	112.7	476.6	407.9	386.4	319.6	47.9	449.9	315.4	248.5	213.0	48.0	-	37.0	95.7	70.1	16.8	26.7	55.5	42.3	36.5
Khentii	112.4	527.1	667.7	198.0	245.2	17.0	326.1	435.3	65.9	125.6	57.5	108.0	164.2	102.0	81.4	37.9	93.0	68.2	30.0	38.1
Ulaanbaatar	178.7	288.4	335.2	340.5	27.5	33.2	49.7	162.2	64.0	12.0	78.3	179.0	165.5	142.9	0.0	67.2	59.7	7.5	133.5	15.5

B. Investment in reconstructed wells, in million MNT

Aimag, capital	Total investment					State budget					Foreign aids, NGOs					Private				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
TOTAL	2542.3	2366.5	1341.1	595.2	1096.2	1144.3	1479.7	980.1	135.6	198.9	1150.4	453.7	110.3	155.9	649.8	247.6	433.1	250.9	303.8	247.5
Western	579.7	607.7	429.5	93.2	111.4	216.1	454.5	396.8	49.8	13.6	336.3	120.4	0.3	27.2	74.7	27.4	32.8	32.4	16.1	23.1
Bayan-Olgii	28.7	25.4	29.1	9.5	3.7	13.4	22.3	28.8	9.3	3.4	14.3	-	-	-	0.0	1.1	3.1	0.3	0.2	0.3
Govi-Altai	209.6	147.9	82.8	32.2	45.3	55.9	133.8	67.1	16.1	1.4	140.7	0.2	-	6.9	33.0	13.1	13.9	15.7	9.3	10.9
Zavkhan	198.5	198.5	112.4	13.0	14.6	75.3	75.3	103.2	-	0.0	118.4	118.4	0.3	11.5	13.2	4.8	4.8	8.9	1.5	1.4
Uvs	68.1	100.0	83.7	33.0	14.1	23.8	95.0	79.8	24.5	4.8	42.3	1.2	-	4.6	6.3	2.1	3.8	3.9	3.9	3.0
Khovd	74.7	135.9	121.5	5.4	33.7	47.7	128.1	117.9	-	4.0	20.7	0.6	-	4.2	22.2	6.3	7.2	3.6	1.3	7.5
Khangai	618.1	532.9	318.9	141.7	301.5	232.6	285.6	201.0	26.9	30.4	336.9	202.3	82.7	42.4	219.1	48.6	45.0	35.2	72.4	52.0
Arkhangai	154.6	155.3	80.6	44.0	50.3	75.3	54.2	60.0	-	11.4	75.7	93.3	15.5	7.4	36.8	3.6	7.8	5.1	36.6	2.1
Bayankhongor	99.1	109.6	58.8	30.4	36.0	45.0	94.9	43.8	9.8	0.9	42.1	-	5.0	6.8	26.0	12.0	14.7	10.0	13.9	9.1
Bulgan	131.6	69.1	83.5	18.4	26.9	50.1	23.2	30.1	13.0	11.0	66.9	43.4	51.8	0.3	11.7	14.7	2.5	1.6	5.0	4.2
Orkhon	138.7	-	-	3.7	3.7	41.1	-	-	3.7	3.7	93.3	-	-	-	0.0	4.2	-	-	-	
Ovorkhangai	93.4	58.3	71.6	17.7	157.0	21.0	44.6	42.8	0.5	3.4	58.8	2.6	10.4	7.0	123.7	13.6	11.1	18.4	10.2	29.9
Khovsgol	0.7	140.6	24.4	27.5	27.6	0.2	68.7	24.3	-	0.0	0.0	63.0	-	20.9	20.9	0.5	8.9	0.1	6.7	6.7
Central	862.7	554.7	388.5	269.6	519.8	433.8	404.1	247.4	56.6	99.9	299.7	73.1	2.5	39.9	292.5	129.1	77.5	138.6	173.1	127.4
Govisumber	31.8	4.3	18.6	7.3	1.1	30.2	2.7	17.8	7.0	0.0	0.0	-	-	-	0.0	1.6	1.6	0.8	0.3	1.1
Darkhan-Uul	206.7	48.1	-	1.7	123.0	90.7	43.7	-	0.6	94.0	92.7	-	-	-	19.8	23.3	4.4	-	1.1	9.2
Dornogovi	167.5	140.8	66.1	26.3	208.6	106.0	125.9	56.6	5.3	0.6	48.0	6.2	1.5	1.5	176.2	13.6	8.7	8.0	19.5	31.8
Dundgovi	146.1	99.7	62.4	14.3	29.7	102.6	88.2	52.5	4.2	0.3	25.0	0.5	-	5.7	24.3	18.5	11.0	9.9	4.4	5.1
Omnogovi	43.3	95.3	82.9	33.1	26.9	39.9	67.9	53.3	6.6	0.0	0.0	-	-	5.1	3.1	3.3	27.4	29.6	21.4	23.8
Selenge	34.1	57.7	61.7	149.7	64.0	25.3	2.4	1.2	32.0	0.0	2.7	41.8	-	4.7	25.0	6.1	13.5	60.5	112.9	39.0
Tov	233.1	108.8	96.8	37.3	66.5	39.2	73.3	66.0	0.9	5.0	131.2	24.6	1.0	22.9	44.1	62.7	10.9	29.8	13.5	17.4
Eastern	469.5	667.5	193.9	86.4	161.5	257.6	333.3	134.8	0.5	53.4	173.9	57.0	22.3	44.6	63.5	37.9	277.2	36.8	41.3	44.6
Dornod	179.6	179.6	75.3	51.0	23.5	140.8	140.8	52.7	-	3.6	20.8	20.8	6.9	32.9	6.4	18.0	18.0	15.7	18.1	13.5
Sukhbaatar	146.3	337.1	60.0	17.7	50.6	95.6	85.9	37.2	0.5	0.1	42.0	-	11.5	7.0	26.1	8.6	251.2	11.3	10.2	24.4
Khentii	143.6	150.8	58.6	17.6	87.4	21.2	106.6	44.9	-	49.7	111.1	36.2	3.9	4.7	31.0	11.3	8.0	9.8	13.0	6.7
Ulaanbaatar	12.2	3.7	10.6	4.4	2.0	4.1	2.2	0.1	1.8	1.6	3.6	0.9	2.5	1.9	0.0	4.6	0.6	8.0	0.8	0.4

Annex 16. Sown area by aimag, in ha

Aimag, capital	2006	2007	2008	2009	2010
TOTAL	162 040.2	202 729.30	192 495.70	282 167.70	315 295.10
Western	6 794.4	8 639.50	8 566.50	9 392.50	12 525.90
Bayan-Olgii	619.5	684.3	709	741.6	1 134.20
Govi-Altai	1 034.2	1 308.20	1 509.50	1 934.40	1 642.80
Zavkhan	607.7	608.7		867.5	1 522.30
Uvs	2 025.8	3 390.70	2 971.40	3 553.00	5 583.00
Khovd	2 507.2	2 647.60	2 776.90	2 296.00	2 643.70
Khangai	31 870.4	34 511.60	32 489.00	52 318.30	60 340.00
Arkhangai	1 420.3	1 631.30	2 291.30	4 810.00	5 307.20
Bayankhongor	375.7	407.1	437.1	484.9	533.1
Bulgan	19 249.1	17 640.30	17 641.10	28 510.20	33 042.30
Orkhon	2 574.0	3 280.30	2 492.10	2 793.50	3 634.20
Ovorkhangai	2 198.1	2 353.40	1 221.40	1 637.90	3 050.60
Khovsgol	6 053.2	9 199.20	8 406.00	14 081.80	14 772.60
Central	108 349.9	147 864.00	143 302.50	207 969.40	226 151.20
Govisumber	27.0	28.7	23	47.3	43.6
Darkhan-Uul	5 746.9	10 781.90	8 234.10	12 064.40	13 706.70
Dornogovi	36.9	32.9	50.5	116.9	96.8
Dundgovi	41.2	43	59.7	99	124.9
Omnogovi	216.1	229	202.3	175.9	155.6
Selenge	74 123.5	101 322.90	105 799.90	145 022.20	147 210.30
Tov	28 158.3	35 425.60	28 933.00	50 443.70	64 813.30
Eastern	13 752.6	10 521.90	6 991.20	11 353.40	15 143.80
Dornod	2 952.8	2 701.90	3 441.80	2 945.40	4 572.70
Sukhbaatar	45.9	64.1	73.4	185.1	261.4
Khentii	10 753.9	7 755.90	3 476.00	8 222.90	10 309.70
Ulaanbaatar	1 272.9	1 192.30	1 146.50	1 134.10	1 134.30

Annex 17. List of the old irrigation systems and surveyed area for the irrigation

No	Aimag	Number of soums	Number of irrigation schemes	Area, ha
1	Arkhangai	3	3	921.0
2	Bayan-Ulgii	9	10	2230.0
3	Bayankhongor	9	13	1181.0
4	Bulgan	3	4	264.0
5	Gobi-Altai	10	17	5547.0
6	Dornod	4	4	1771.0
7	Dornogobi	3	3	319.0
8	Zavkhan	11	14	1651.0
9	Uvurkhangai	5	5	3735.0
10	Umnugobi	8	14	388.0
11	Sukhbaatar	3	3	90.0
12	Selenge	7	11	6067.0
13	Tuv	8	13	3674
14	Uvs	10	11	7063
15	Khovd	11	13	5684
16	Khuvsgul	2	3	307
17	Khentii	5	5	1530
18	Darkhan-Uul	3	6	130
19	Orkhon	1	1	547
20	Ulaanbaatar	3	7	986
Total				45160

Annex 18. Irrigated area and crops by aimag

2008

Capital and aimag	Sown area. ha							Crops, ton						Yield of per ha, centner		
	Total	Wheat	Potatoes	Vegetables	Planted forage	Fruit	others	Wheat	Potatoes	Vegetables	Planted forage	Fruit	others	Wheat	Potatoes	Vegetables
Total of Country	30016.6	7388.2	8858.4	6089.1	5023.7	1843.8	813.5	16446.2	103384	75588.4	15209.1	467.3	5505.7	22.3	116.7	124.1
Western region	13290.7	3987.2	1912.5	1364.8	4184.9	1457.8	383.5	4914.5	19889.6	12690.8	11954.8	217.6	4680.7	12.3	104.0	93.0
Bayan-Olgii	3362.3	6.5	330.9	110.0	2906.3	8.6		5.9	3448.4	1032.8	3812.3	8.6		9.1	104.2	93.9
Govi-Altai	1731.1	714.2	231.6	124.0	409.4	67.4	184.5	901.7	1331.9	483.7	1532.9	131.8	4382.0	12.6	57.5	39.0
Zavkhan	423.3		237.1	98.0	88.2	0.0		0.0	2233.9	1076.2	125.0				94.2	109.8
Uvs	4999.9	2584.0	221.4	177.7	436.0	1381.8	199.0	3303.3	4306.3	3652.6	5449.0	77.2	298.7	12.8	194.5	205.6
Khovd	2774.1	682.5	891.5	855.1	345.0			703.6	8569.1	6445.5	1035.6			10.3	96.1	75.4
Khangai region	3903.8	730.0	1723.4	1066.0	94.5	289.9	0.0	1469.7	18873.2	10033.6	241.4	2.5	0.0	20.1	109.5	94.1
Arkhangai	363.5	160.0	171.5	32.0				180.0	1334.0	241.0					77.8	75.3
Bayankhongor	437.1	4.0	229.2	137.1	66.8	0.0		3.7	1730.0	1052.0	184.4				75.5	76.7
Bulgan	1300.3	306.0	648.3	237.3	0.0	108.7		571.0	7488.0	2455.5	0.0	1.2			115.5	103.5
Orkhon	819.0	120.0	250.0	447.0	0.0	2.0		293.0	4299.0	4257.0	0.0	0.3		24.4	172.0	95.2
Ovorkhangai	522.2		204.2	111.1	27.7	179.2			1755.5	1164.7	57.0	1.0			86.0	104.8
Khovsgol	461.7	140.0	220.2	101.5				422.0	2266.7	863.4				30.1	102.9	85.1
Central region	10286.3	2201.0	4027.0	3108.4	423.9	96.0	430.0	9216.0	56100.2	46780.1	1151.0	247.2	825.0	41.9	139.3	150.5
Govisumber	12.6		9.5	3.1					31.4	20.7					33.0	66.6
Darkhan-Uul	1430.0		801.3	605.9		22.8			11166.2	7487.1		195.0			139.4	123.6
Dornogovi	50.0		18.0	32.0					117.0	960.0					65.0	300.0
Dundgovi	50.1		33.6	12.4	3.8	0.3		0.0	217.3	35.3		1.2			64.7	28.4
Omnogovi	205.4		117.6	59.8	24.1	3.9			1026.0	543.0	222.0	1.0			87.2	90.8
Selenge	6620.8	2201.0	2102.7	1578.1	276.0	33.0	430.0	9216.0	32389.2	29576.5	690.0		825.0	41.9	154.0	187.4
Tov	1930.0		953.8	820.2	120.0	36.0			11184.5	8178.2	239.0	50.0			117.3	99.7
Eastern region	1132.4	470.0	450.3	197.5	14.5	0.1	0.0	846.0	3395.4	1871.7	11.1	0.0	0.0	18.0	75.4	94.8
Dornod	556.1	470.0	66.5	8.5	11.0	0.1		846.0	403.2	70.1				18.0	60.6	82.5
Sukhbaatar	50.3	0.0	22.3	24.5	3.5	0.0			191.4	181.9	11.1				85.8	74.2
Khentii	526.0		361.5	164.5	0.0				2800.8	1619.7	0.0				77.5	98.5
Ulaanbaatar	1390.8		735.6	349.3	305.9				5093.9	4191.6	1850.8				69.2	120.0

2010

Capital and aimag	Sown area, ha							Crops, ton						Yield of per ha, centner		
	Total	Wheat	Potatoes	Vegetables	Planted forage	Fruit	others	Wheat	Potatoes	Vegetables	Planted forage	Fruit	others	Wheat	Potatoes	Vegetables
Total of Country	36993.5	9428.3	9944.8	6118.7	3738.5	589.3	7688.3	19178.0	122378.3	80463.6	10045.1	258.2	40957.6	20.3	123.1	131.5
Western region	15823.4	2929.5	1917.2	1189.5	2478.2	255.0	7054.0	5057.3	21682.5	13432.2	6521.3	191.8	40125.0	17.3	113.1	112.9
Bayan-Olgii	4400.7	18.8	343.0	126.5	623.4	20.0	3269.0	60.0	3911.1	1403.1	1114.0	21.0	4557.0	31.9	114.0	110.9
Govi-Altai	3513.9	597.4	198.4	117.7	590.0	79.3	1931.0	825.2	1521.4	2168.1	1364.0	94.6	1300.0	13.8	76.7	184.2
Zavkhan	1079.7	250.0	248.1	103.3	447.0	31.3		613.9	2168.8	1044.8	1348.9			24.6	87.4	101.1
Uvs	4174.7	1343.0	226.0	169.0	458.3	124.4	1854.0	2987.0	2273.6	1841.8	1008.1	76.2	34268.0	22.2	100.6	109.0
Khovd	2654.5	720.3	901.7	673.0	359.5			571.2	11807.6	6974.4	1686.3			7.9	130.9	103.6
Khangai region	5437.9	1430.0	2102.3	1214.9	311.4	288.3	91.0	2176.7	19409.5	12557.7	763.0	18.4	202.0	15.2	92.3	103.4
Arkhangai	493.4	120.0	276.2	86.2		11.0		263.0	2398.0	928.5	0.0			21.9	86.8	107.7
Bayankhongor	574.0	47.1	271.8	136.1	119.0	0.0		12.7	2418.6	1218.9	394.0			2.7	89.0	89.6
Bulgan	1898.4	794.0	633.2	323.0		148.2		784.0	5316.6	3215.7	0.0	9.1		9.9	84.0	99.6
Orkhon	1129.7	428.9	318.0	368.0		14.8		1012.0	3856.0	4301.0	0.0	0.7		23.6	121.3	116.9
Ovorkhangai	764.8		281.4	145.7	132.4	114.3	91.0		2657.4	1535.8	249.0	8.6	202.0		94.4	105.4
Khovsgol	577.6	40.0	321.7	155.9	60.0	0.0		105.0	2762.9	1357.8	120.0			26.3	85.9	87.1
Central region	12544.4	4618.8	4544.6	2922.0	391.2	39.2	543.0	11093.5	66841.6	45557.3	2083.2	46.8	620.0	24.0	147.1	155.9
Govisumber	59.1		9.1	12.0	28.0		10.0		91.9	69.0	50.0		20.0		101.0	57.5
Darkhan-Uul	2128.4	338.0	939.0	798.5	40.0	12.9		290.0	9852.0	9295.2	138.4	2.9		8.6	104.9	116.4
Dornogovi	100.5		35.7	41.4	13.6	9.8			208.3	297.6	103.1				58.3	72.0
Dundgovi	100.1		35.7	18.2	38.5	7.7			176.7	32.3	19.2	1.0			49.5	17.8
Omnogovi	173.1		96.1	45.9	22.3	8.8			693.9	463.2	285.5	2.9			72.2	100.9
Selenge	9283.2	3707.2	3066.9	1886.1	80.0	0.0	543.0	9833.9	45049.7	31444.0	200.0	0.0	620.0	26.5	146.9	166.7
Tov	699.9	573.6	371.2	131.9	196.8	0.0	0.0	969.6	10861.0	4025.0	1337.0	40.0	0.0	16.9	292.6	305.2
Eastern region	1798.8	450.0	773.2	353.1	215.4	6.8	0.3	850.5	8062.5	4175.6	275.5	1.2	10.6	18.9	104.3	118.3
Dornod	1090.8	450.0	300.5	131.2	202.0	6.8	0.3	850.5	3229.2	1540.8	260.0	1.2	10.6	18.9	107.5	117.4
Sukhbaatar	98.4		56.0	29.0	13.4				438.6	211.6	15.5				78.3	73.0
Khentii	609.6		416.7	192.9					4394.7	2423.2					105.5	125.6
Ulaanbaatar	1389.0		607.5	439.3	342.3				6382.2	4740.8	402.1				105.1	107.9

Annex 19. Mining licenses by aimag first half of 2011

Aimag and Capital	Total		Of which:			
			Exploration		Exploitation	
	Number of Licenses	Area, 000′ ha	Number of Licenses	Area, 000′ ha	Number of Licenses	Area, 000′ ha
Total	4 799*	24 368.9	3508*	23 838.8	1291*	1 058.4
Arkhangai	78	192.9	50	184.2	28	8.7
Bayan-Ulgii	124	737.2	105	731.4	19	5.8
Bayankhongor	231	1 395.3	172	1 380.3	59	15.0
Bulgan	148	742.5	90	727.4	58	15.1
Gobi-Altai	287	3 275.6	275	3 274.4	12	1.2
Dornogobi	509	2 770.8	398	2 743.5	111	27.2
Dornod	226	1 334.1	178	1 318.0	48	16.2
Dundgobi	268	1 122.1	218	1 110.5	50	11.7
Zavkhan	102	537.3	97	530.5	5	6.8
Uvurkhangai	88	338.8	57	326.8	31	12.0
Umnugobi	470	6 253.3	406	5 975.8	64	277.5
Sukhbaatar	212	1 248.2	178	1 239.9	34	8.3
Selenge	360	418.7	220	389.5	140	29.2
Tuv	530	743.7	307	702.0	223	41.7
Uvs	185	789.0	141	783.0	44	6.0
Khovd	161	1 216.3	143	1 212.5	18	3.8
Khuvsgul	103	322.7	88	321.4	15	1.3
Khentii	298	699.2	217	685.2	81	14.0
Darkhan-Uul	141	55.6	65	47.0	76	8.6
Ulaanbaatar	231	19.6	71	7.9	160	11.7
Orkhon	16	19.8	9	17.1	7	2.7
Gobisumber	31	135.3	23	130.6	8	4.7

**geminate number*

Annex 20. Mining licenses by River Basin, 2009

No	River basins	Number of Licenses		Area, km^2
		exploration	exploitation	
1	Selenge	74	5	9.8
2	Khuvsgul-Eg	70	7	355.8
3	Shishkhid	21	2	961.9
4	Delgermurun	51	10	961.9
5	Ider	16	0	0
6	Chuluut	41	1	0.9
7	Khanui	12	0	0
8	Tuul	220	83	259.7
9	Orkhon	173	120	211.7
10	Kharaa	161	73	161.2
11	Eroo	92	73	147.4
12	Onon	95	70	199.7
13	Ulz	159	15	8.1
14	Kherlen	354	33	60.4
15	Buir-Khalkh	7	3	0.9
16	Menengiin Tal	100	12	11.0
17	Umard goviin guveet-Khalhiin dundad tal	1092	208	453.3
18	Galba-Uush-Doloodiin govi	371	30	1680.7
19	Ongi	100	25	132.1
20	Altain Uvur Gobi	522	27	553.9
21	Taats	33	28	84.5
22	Orog-Tui	18	3	4.0
23	Buuntsagaan-Baidrag	93	4	49.6
24	Khyargas-Zavkhan	193	46	99.5
25	Khuisiin Govi-Tsetseg lake	157	1	0.3
26	Uyench-Bodonch	53	14	40.9
27	Bulgan	100	8	84.7
28	Khar Nuur-Khovd	157	9	360.0
29	Uvs Lake - Tes	522	21	215.9
	Total	4674	931	6230.7

Annex 21. Mining deposits approved by the 27th resolution of the State Great Khural of Mongolia from 2007

No	Deposits	Type of mineral	location
1.	Ulaan-Ovoo[1]	Coal	Selenge, Tushig
2.	Uvdug Khudag[2]	Coal	Dundgobi, Bayanjargalan
3.	Bayanteeg[3]	Coal	Uvurkhangai, Nariinteel
4.	Nuurst khotgor[3]	Coal	Uvs, Bukhmurun
5.	Khar Tarvagatai	Coal	Uvs, Umnugobi
6.	Aduunchuluun[3]	Coal	Dornod Kherlen
7.	Tevshiin gobi[3]	Coal	Dundgobi, Saintsagaan
8.	Talbulag[3]	Coal	Sukhbaatar, Baruum-urt
9.	Chandgan tal[2]	Coal	Khentey, Murun
10.	Khuutiin khonkhor[1]	Coal	Dundbobi8 bayanjargalan
11.	Khuut[1]	Coal	Dornod, Matad
12.	Nalaikh[4]	Coal	Ulaanbaatar, Nalaikh
13.	Alag togoo[5]	Coal	Dornogobi, Dalanjargalan
14.	Zeegt[2]	Coal	Gobi-Altai, Chandmani
15.	Mogoin gol[2]	Coal	Khubsugul, Tsetserleg
16.	Saikhan ovoo[2]	Coal	Bulgan, Saikhan
17.	Bargilt[6]	Iron ore	Khentey, Darkhan
18.	Tugrog lake[6]	Coal	Tuv, Bayan
19.	Naran tolgoi[3]	Gold	Tuv, Jargalant
20.	Tavt[5]	Gold	Bulgan Teshig
21.	Tumortolgoi[7]	Iron ore	Darkhan-uul Khongor
22.	Bayan davaa deposit[1]	Tin, tangsten	Tuv Erdene
23.	Ulaan uul[3]	Tin, tangsten	Bayan-ulgii Ulaankhus
24.	Janchivlan deposit[1]	Tin, tangsten	Tuv Erdene
25.	Tsagaan davaa[2]	Tin, tangsten	Tuv Bayanchandmani
26.	Mungun undor[6]	Silver	Khentey Umnudelger
27.	Khukh adar[5]	Copper, zink	Bayan-Ulgii Tolbo
28.	Shavriin tsaram[2]	Pyrope	Arkhangai Tariat
29.	Shuden uul[1]	Rock salt	Uvs Davst
30.	Shiree uul[1]	Gypsum	Dundgobi Delgerkhangai
31.	Uvdug khudag[2]	Coal	Dundgobi Undurshil
32.	Tsadam nuur[8]	Coal	Tuv bayan
33.	Tsagaan tsav[2]	Zeolite	Dornogobi Saikhandulaan
34.	Mankhan uul[1]	Phosphorite	Khubsugul Alag-Erdene
35.	Ongilog nuur[1]	Phosphorite	Khubsugul Alag-Erdene
36.	Lugiin river[8]	Газрын ховор элемент	Dornogobi Khatanbulag
37.	Khongor[1]	Flour spar	Dornogobi, Dalanjargalan, Airag
38.	Ulaan[1]	Zink, lead (plumbum)	Dornod Dashbalbar
39.	Tsav[1]	Zink, lead (plumbum)	Dornod Choibalsan

Explanation:
[1]- *Exploration from State Budget.*
[2]- *Exploration from State Budget and operating.*
[3]- *Operating by LLC.*
[4]- *Exploration from State Budget, technical specifications - became heavy (worse)*
[5]- *Exploration from State Budget, Additional Exploration from Private source*
[6]- *Not registered to the State mineral fund.*
[7]- *License expired*
[8]- *deposit type under C2.*

Annex 22. Coal Deposits of Mongolia

Aimag	Deposits	Number	Reserves (million t)	Share to the total reserves, %
Tuv Selenge Bulgan Darkhan-Uul Orkhon	1. Ulaan-Ovoo 2. Baganuur 3. Tsaidam lake 4. Tugrug lake 5. Saikhan ovoo 6. Maanit 7. Tsogtiin gol 8. Shariin gol 9. Nalaikh 10.Nuurst khonkhor 11. Baruun galt 12. Onjuul 13. Ereen	13	26528.1	16.5
Khuvsgul Arkhangai Uvurkhangai Bayankhongor	1. Khotgor 2. Bayanteeg 3. Mogoin gol 4. Jilchig bulag 5. Bayanduurkh 6. Alg Tsakhirt 7. Bayantsagaan 8. Eg gol 9. Shargain nuruu 10. Uvurchuluut 11. Mungush 12. Khugshin gol 13. Uilgan gol	13	7704.1	4.7
Umnugobi Dornogobi Dundgobi Gobisumber	1. Tavan tolgoi 2. Nariin Sukhait 3. Gurvan tes 4. Tsagaan ovoo 5.Baruun Naran 6.Tushleg uul 7.Khootiin khonkhor 8.Shivee-Ovoo 9.Olongiin ukhaa 10.Khashaat khudag 11.Khamriin khural 12.Tevshiin Gobi 13.Erdenebulag 14.Alag togoo 15.Ikh Ulaan Lake 16.Ovoot Tolgoi 17.Uvdug khudag 18.Jargalant 19.Jinst khudag 20.Dalan	20	49785.3	30.6
Bayan-Ulgii Uvs Khovd Gobi-Altai Zavkhan	1.Nuurstkhotgor 2.Khar tarvagatai 3.Khuden 4.Yavar 5.Khushuut 6.Olonbulag 7.Zeegt 8.Khuren gol 9.Rashaant gol 10.Tsahiurt 11.Zulegt Gol 12.Mantag 15.Gants Mod 16.Bumbat khudag 17.Burgaztain gol 18.Jargalant 19.Maanit 20.Tohom 21.Chuluut Zeegt 22.Khujirt 23.Tsahir khudag	21	27157.9	16.7
Dornod Sukhbaatar Khentii	1.Talbulag 2.Bayantsogt 3.Aduunchuluun 4.Chandgana tal 5.Baishint 6.Bayanbulag 7.Utaat menjuur rashaan 8.Khuut 9.Khulst lake 10.Jargalant 11.Khutag 12.Bus Ovoo 13.Bulangiin khooloi 14.Ulziit 15.Zuun bulag 16.Murun	16	51165.1	31.5
Total		83	162340.5	100

Annex 23. Planned new small and medium enterprises

178th Resolution of GoM of 2009: Concept of Local Industry Development

Type of entities	Western					Khangai						Central							Eastern			Ulaanbaatar
	Bayan-Ulgii	Gobi-Altai	Zavkhan	Uvs	Khovd	Arkhangai	Bayankhongor	Bulgan	Orkhon	Uvurkhangai	Khubsugul	Gobisumber	Darkhan-Uul	Dornogobi	Dundgobi	Umnugobi	Selenge	Tuv	Dornod	Sukhbaatar	Khentii	
Primary meat processing industry		+					+								+							
Livestock fattening industry								+			+		+				+	+			+	
Best breed livestock farms	+	+	+	+	+	+	+	+			+	+			+	+		+	+	+	+	
Milk processing industry						+	+				+								+			
Milk processing shop (in one soum)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Milk cooling centers						+		+	+	+	+		+		+		++	+				+
Dairy farms of 50 cows	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Forage farming	+	+		+	+		+			+			+					+	+	+		
Greenhouse (all soums)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Vegetable Processing industry, shops					+				+							+	+	+				
Potato and vegetable storage mechanized pit																						+
Greenhouse industry																						+
Fruit Processing industry, shops			+	+		+			+		+						+	+			+	
Salt works			+	+														+	+			+
Starch Plant					+												+	+				
Fish farming		+	+		+	+					+											
Poultry farm (new and expand)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Service center and poins (aimag, soum)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Wool-washing plant, felt factory	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Garment industry	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Woodworking plant (new and expand)			+			+		+			+					+	+		+			

Type of entities	Western					Khangai						Central							Eastern			Ulaanbaatar
	Bayan-Ulgii	Gobi-Altai	Zavkhan	Uvs	Khovd	Arkhangai	Bayankhongor	Bulgan	Orkhon	Uvurkhangai	Khubsugul	Gobisumber	Darkhan-Uul	Dornogobi	Dundgobi	Umnugobi	Selenge	Tuv	Dornod	Sukhbaatar	Khentii	
Stone processing plant					+				+					+								
Electronic, electrical equipment factory													+					+				
Factory packaging of liquid fuel				+	+																	
Squeezed and smokeless fuel plant									+				+									+
Small factory metal structures and (new and expand)									+				+						+			
Small and medium enterprises producing goods for export and import-substitution products									+				+									+
Experimental waste processing plant							+															+
Cement plant		+					+							+							+	

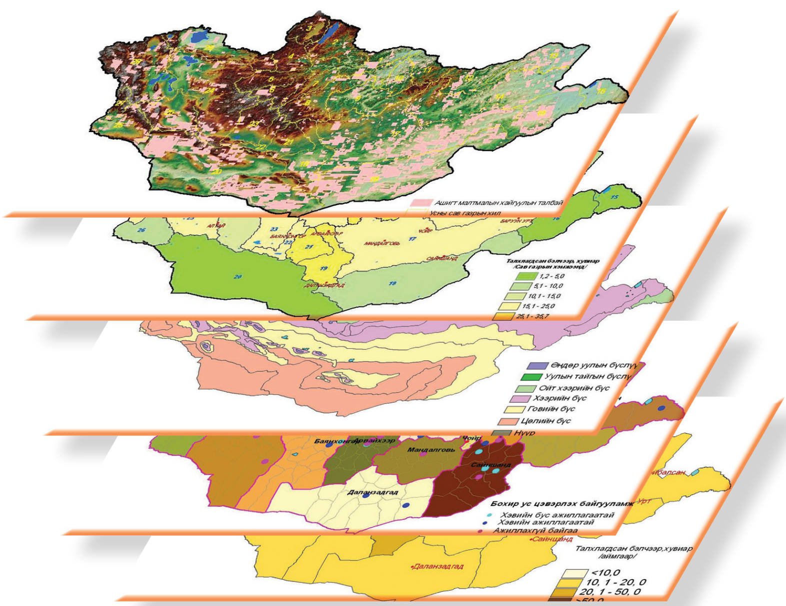
- Create fruit, berry and sea buckthorn plantations in the aimags with convenient climate conditions;
- Set and expand beekeeping in the aimags with enough honey-plant reserves;
- Establish wastepaper and package factory choosing a place;
- Establish building glass plant;
- Establish metallurgy in the Central and Khangai region;
- Establish high technological factories choosing a place;
- Establish cashmere processing industries in the regions;
- Establish wool processing factories;
- Establish dairy factory on the region level;
- Establish and extend meats deeply processing plants based on regional meat processing factories;
- Establish pits and receptacles

Part 2.
LAND USE

Prepared by: P.Khishigsuren[1]

Revised by: Wim vander Linden[1]

[1] *"Strengthening Integrated Water Resource Management in Mongolia" project*



Contents

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List of Figures

1. Introduction

This report contains the description of the geography, topography, soil, vegetation, land use and land degradation of Mongolia. It has 5 chapters, 33 Figures, 13 tables and 3 Annexes. Annexes are included providing a general description of pasture, soil and protected areas.

2. Data and Information Used

2.1. Existing data and their sources

The used data list and their sources are shown in Table 1.

Table 1. Used data

Data	Data type	Data source	Name of contact	Remarks
Administrative boundary	vector	http://geodata.mne-ngic.mn	mtt@magicnet.mn	Polygon data of aimag and soums
Soil	vector	http://geodata.mne-ngic.mn	mtt@magicnet.mn	1981
Vegetation	vector	http://geodata.mne-ngic.mn	mtt@magicnet.mn	2005
Natural zones	vector	http://geodata.mne-ngic.mn	mtt@magicnet.mn	1981
Forest	vector	Forest agency, MENT	Mr. Erdenebat	
Land use	vector	http://geodata.mne-ngic.mn	mtt@magicnet.mn	2005
Protected areas	vector	http://geodata.mne-ngic.mn	mtt@magicnet.mn	2008
Land cover	jpeg	http://geodata.mne-ngic.mn	mtt@magicnet.mn	1992, 2002, 2008
Pasture degradation	vector	National atlas of Mongolia, 2009		2005 data
Exploration and exploitation	vector	WA, MENT	G.MunkhErdem	2010
Desertification	jpeg	Institute of Geoecology, MAS	D.Dash	1990, 2000, 2008 data
Land reports 2008, 2010	table	ALACGAC	G.Bayarjargal	2008,2010

2.2. Reports and other documents and their sources

The used reports and other documents and their sources are shown in Table 2.

Table 2. List of reports

Report name	Author	Affiliation	Short description
Land resources of Mongolia, its assessment of appropriate use and protection	Ya.Baasandorj	Geoecology Institute	It includes description of land classification, land classes area and information on land use
National consultant's report/ Agriculture policy, Landuse, Pasture etc/	G.Davaadorj	Ministry of Food, Agriculture and Light Industries	It includes information on pasture, arable land and irrigation land
National consultant's report/ Forest policy/	A.Avirmed	Forest Agency	General description of forest, its type and past and future measures on forest policy

The reports used are also included in the list of references at the end of the report.

3. Methodology

3.1. Land fund

In our country, the land fund is divided into 6 main categories, providing the basic information data. According to the Land Law of 1971 the land was classified as agricultural area, settlement area, protected areas, forest areas, water bodies and reserve land; in 1998 the Land Law was renewed and approved by the Government of Mongolia in which the protected areas where removed and roads and other infrastructure areas were added as an independent group. However, in 2004 by abrogation of the law the state reserve land was removed as independent group and the protected areas were re-introduced.

As specified in the Land Law of Mongolia currently 6 classifications are adhered to:

1. Agricultural area
2. Settlement area
3. Roads and other infrastructure areas
4. Forest areas
5. Water bodies
6. Protected areas

Satellite data, DEM, remote sensing methodology and standard GIS models and functions were used to evaluate the land use, land cover, soil, vegetation, population, head of livestock density, environmentally protected areas, exploration and exploitation areas.

3.2. Geography, topography and administration

The maps presented were prepared in ArcGIS as described below:

- The physical geography map was obtained from the National Atlas of Mongolia.
- The elevation map was derived from SRTM elevation data downloaded from http://srtm.csi.cgiar.org//
- The river basin map was prepared by the project. The boundaries of the basins were determined in 2009 by a working group established by the project.
- The map with river basin types was prepared by the project.
- The map with the surface water network was prepared by the project. The surface water network was digitized by NGIC staff.
- The map with the administrative boundaries of aimags and soums was prepared by the project using administrative boundaries supplied to the project by NGIC

The geographical data are presented in the maps using the WGS 1984 projection (UTM zone 48N). The areas used were determined in this projection.

The official area of the country and the area calculated by GIS methodology are different because of the differences in methodology.

3.3. Land cover

The land cover maps presented were prepared in ArcGIS as described below:

- The land cover map of 1992 was obtained from the NGIC Database.
- The land cover map of 2002 was obtained from the NGIC Database.
- The land cover map of 2006/2008 was obtained from the NGIC Database.

The legend of the maps was determined by ICC.

The natural zones map was prepared by WWF and published in 2002.

3.4. Land use

The data on land use areas was obtained from “Land report 2008”, as it was described in the reports by the project agricultural consultant G. Davaadorj.

The land use maps presented were prepared in ArcGIS as described below:

- The land use map of 1981 was obtained from NGIC Database.

3.5. Agricultural land

The data and description of the agricultural land areas was obtained from “Land report 2008” as it was described in the reports by the project agricultural consultant G. Davaadorj and the project land use consultant Ya. Baasandorj.

The graph on the change in pasture land area and livestock population was obtained from Institute of Geoecology, MAS, as it was described in the report by the project land use consultant Ya. Baasandorj.

The maps presented were prepared in ArcGIS as described below:

- The pasture map of Mongolia was obtained from National atlas of Mongolia, 2009

3.6. Soil and vegetation

The data and description of the soil and vegetation was obtained from NGIC Database as it was described in the reports by the project agricultural consultant G. Davaadorj and the project land use consultant Ya. Baasandorj.

The maps presented were prepared in ArcGIS as described below:

- The vegetation map of Mongolia was obtained from NGIC Database.
- The soil map of Mongolia was obtained from NGIC Database.

3.7. Soil erosion, pasture land degradation and desertification

The data and description of the soil erosion and pasture land degradation was obtained from NGIC Database as it was described in the reports by the project agricultural consultant G. Davaadorj and the project land use consultant Ya. Baasandorj.

The data and description of the desertification was obtained from Institute of Geoecology, MAS as it was described in the report by the project land use consultant Ya. Baasandorj.

The maps presented were prepared in ArcGIS as described below:

- The pasture degradation map of Mongolia was obtained from ALACGAC.
- The soil erosion map of Mongolia was obtained from National atlas of Mongolia.
- The desertification map of Mongolia was obtained from Institute Geoecology, MAS.

3.8. Protected areas and forest

The data and description of the protected areas was obtained from NGIC Database.

The data and description of the forest areas was obtained from the project land use consultant Ya. Baasandorj

The maps presented were prepared in ArcGIS as described below:

- The protected areas map of Mongolia was obtained from NGIC Database.
- The forest map of Mongolia was obtained from Forest Agency, MENT

3.9. Urban areas and mining

The data and description of the urban and settlement area was obtained from Land Report, 2010 and from the project land use consultant Ya. Baasandorj.

The data of the license and mining areas was obtained from WA.

The maps presented were prepared in ArcGIS as described below:

- The map of the exploitation and exploration areas of Mongolia was obtained from WA.

3.10. Major issues

The list of major issues was prepared based on information from the project consultants G. Davaadorj and Ya. Baasandorj.

4. Land use

4.1. Geography

Mongolia is located inland in Northeast Central Asia, between China and Russia. It is highly elevated with an average elevation of 1580 m above sea level forming the transition zone between the great Siberian taiga and the Central Asian desert.

Mongolia is listed as the eighteenth largest country in the world by its territory and the least densely populated country (1.78 persons per sq. km). The total territory of Mongolia is 1,564,000 km^2. The distance from west to east is 2392 km and from north to south is 1259 km. It borders on Russia to the north (3485 km border) and China to the south (4677 km border).

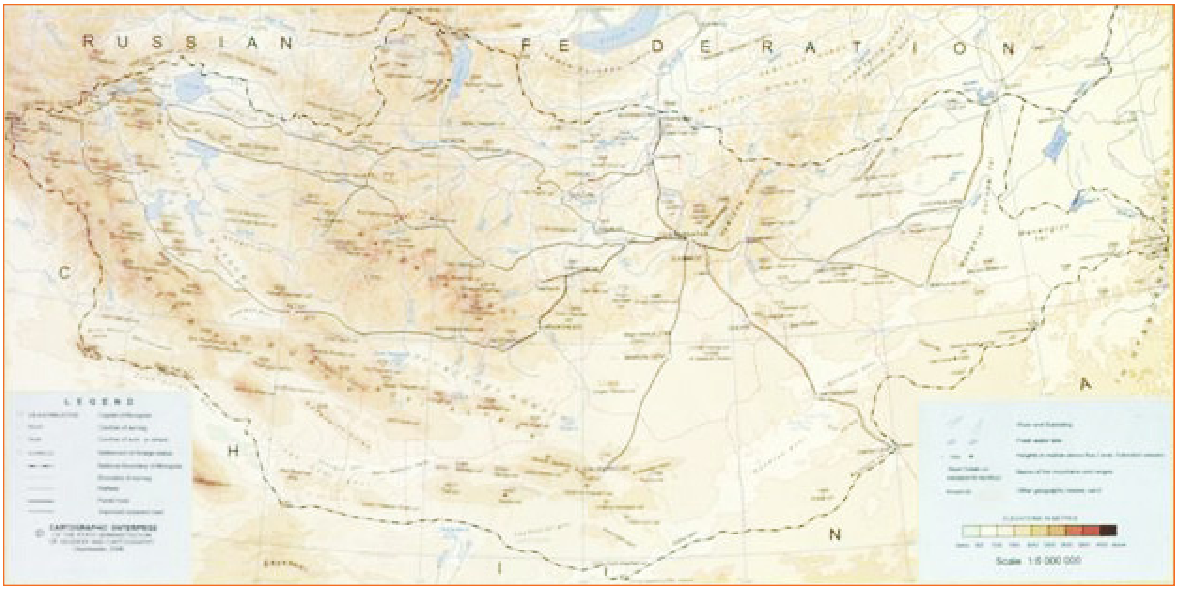

Figure 1. Physical geography map

4.2. Topography

The highest point in Mongolia is Khuiten Mountain at 4374 m above sea level; the lowest point is Khukh Nuur valley at 532 m. The capital city Ulaanbaatar has an elevation of 1350 m above sea level. The other two main cities, Darkhan and Erdenet, are located 230 km north and 370 km northwest from the capital city, respectively.

The territory of Mongolia belongs to 3 water basins: 19.5% belongs to the Arctic basin, 11.5% to the Pacific basin and 69% belongs to the Central Asian basin without external flow. The crossing point of the basins, Khundlun Uul, is at an elevation of 1854 m above the sea level in Erdene soum of Tuv aimag at about 60 km southeast from Ulaanbaatar.

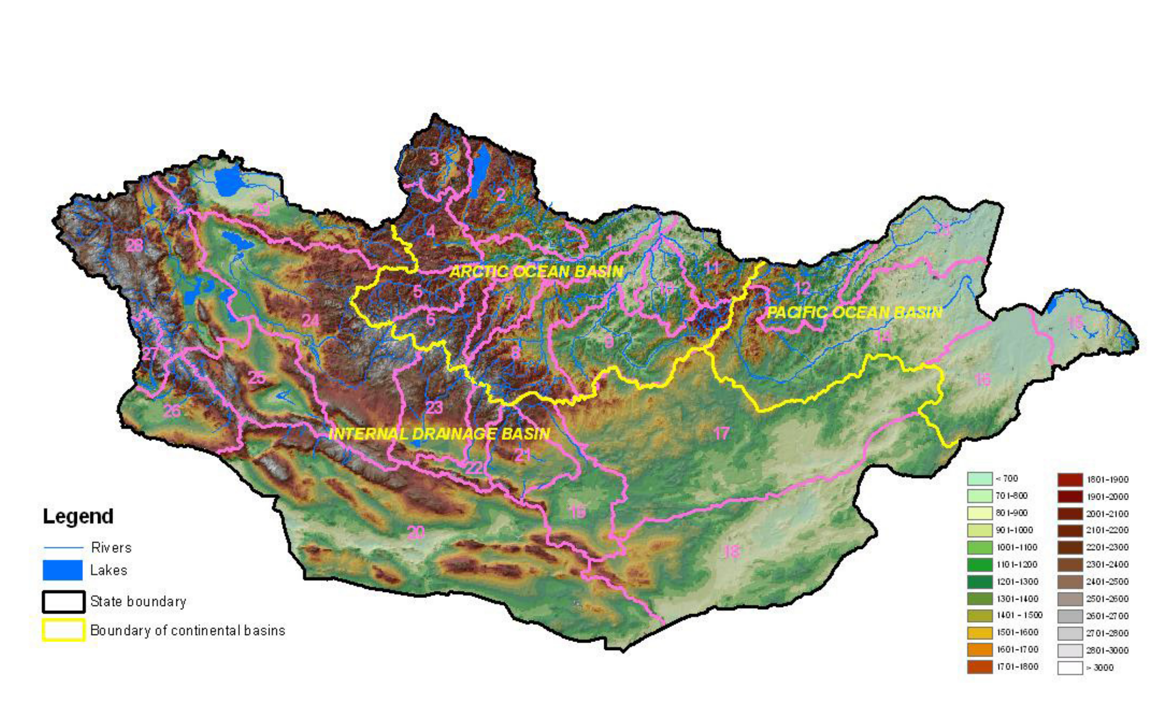

Figure 2. Elevation map

The territory of Mongolia was divided in 29 basins representing the main river basins (Table 3 and Figure 2). The basin boundaries were determined using the surface water catchment boundaries. The number of basins was decided after consultation with water resources experts. The basins will be used for the planning of the water resources in the country.

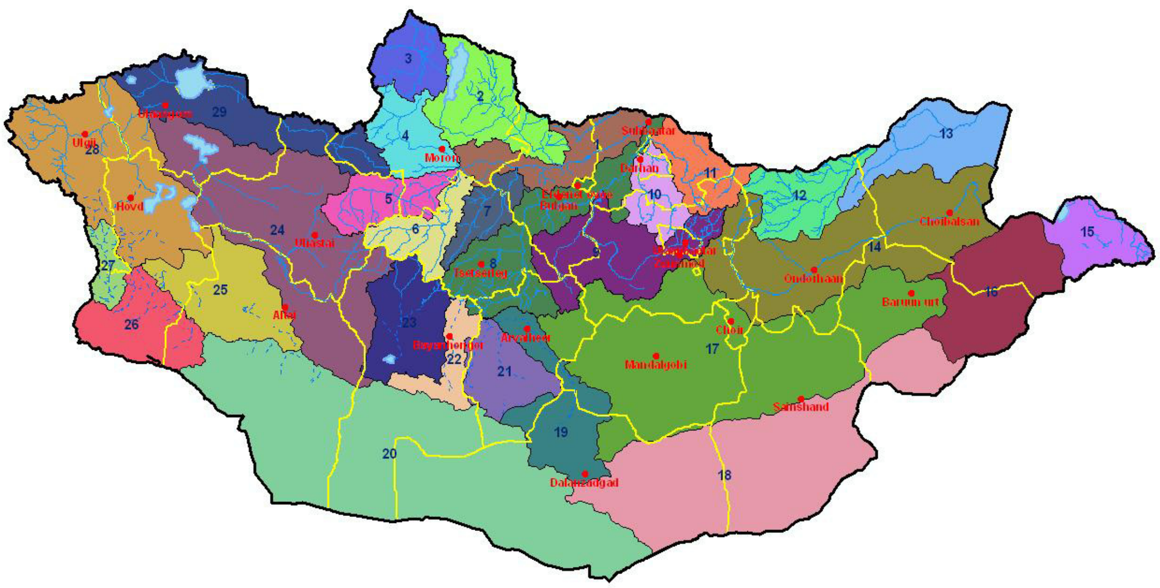

Figure 3. River basins of Mongolia (aimag boundaries in yellow)

Table 3. River Basins of Mongolia

Nr	Name	Area (km²)	Continental basin	Basin type
1	Selenge	31,395	Arctic basin	Surface water
2	Khuvsgul-Eg	41,871		
3	Shishkhid	20,362		
4	Delgermurun	23,324		
5	Ider	23,061		
6	Chuluut	20,078		
7	Khanui	15,755		
8	Orkhon	52,753		
9	Tuul	49,416		
10	Kharaa	17,697		
11	Eroo	22,280		
12	Onon	28,241	Pacific basin	
13	Ulz	37,961		
14	Kherlen	107,906		
15	Buir-Khalkh	23,756		Combined SW-GW
16	Menengiin Tal	54,082		Groundwater
17	Umard Goviin Guveet-Khalhiin Dundad Tal	180,555	Central Asian basin	
18	Galba-Uush-Doloodiin govi	142,287		
19	Ongi	39,724		Combined SW-GW
20	Altain Uvur Gobi	221,156		Groundwater
21	Taats	25,425		Combined SW-GW
22	Orog-Tui	15,735		
23	Baidrag-Buuntsagaan	35,622		
24	Khyargas-Zavkhan	122,315		Surface water
25	Khuisiin Govi-Tsetseg lake	43,024		Combined SW-GW
26	Uyench-Bodonch	34,491		
27	Bulgan	10,155		Surface water
28	Khar nuur-Khovd	88,936		
29	Uvs Lake - Tes	54,223		
	Total	1,564,116		

The areas shown in the above table are derived from the Government Decree defining the river basins. The areas are determined on base of topographical map with scale 1:1 000 000.

The basins may be divided in three groups according the dominant water source (Figure 4):

- Surface water basins, located in the northern part of Mongolia; these basins have large permanently flowing rivers;
- Groundwater basins in the southern part of Mongolia; these basins do not have permanently flowing rivers and shallow or deep groundwater is the dominant water source;
- Combined surface water / groundwater basins; these basins have permanently flowing rivers in a small part of the basin and groundwater as dominant source in the major part of the basin.

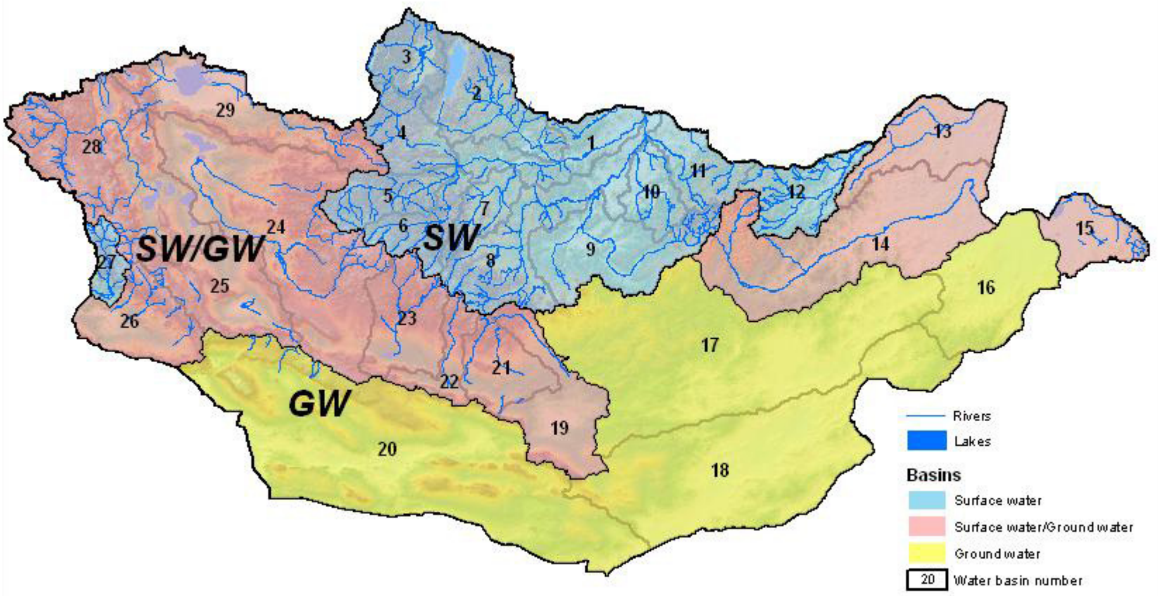

Figure 4. Area of surface water and groundwater basin types

The surface water network (Figure 5 shows the main rivers only) was digitized by NGIC staff (with assistance from the IWRM project) from topographical maps with scale 1:100,000 which are created by russian methodology and published between 1972 to 1986. Those maps are in projection Gaus Kruger, datum Pulkovo 1942, ellipsoid Krasovskii.

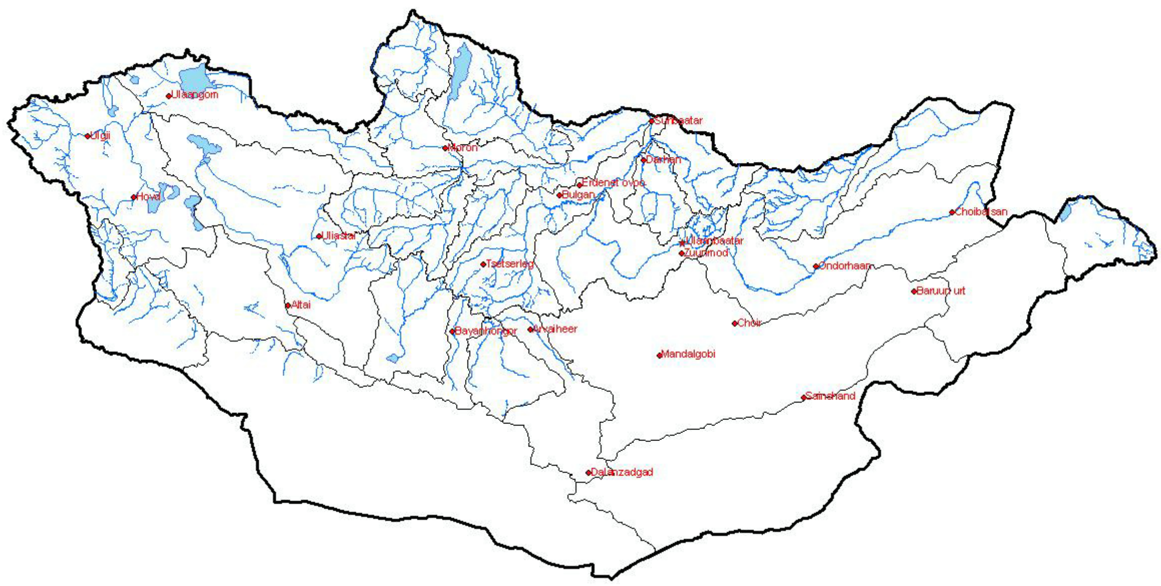

Figure 5. Surface water network (main rivers, lakes and basin boundaries)

4.3. Administration

Mongolia is a parliamentary republic divided administratively into 21 aimags (provinces, see Table 4) and a capital city. Aimags are subdivided into 329 soums and soums are divided into bags. The capital city is divided into 9 districts and districts are divided into khoroos. Baganuur and Bagakhangai districts are located separately to the east from Ulaanbaatar city (see Figure 7).

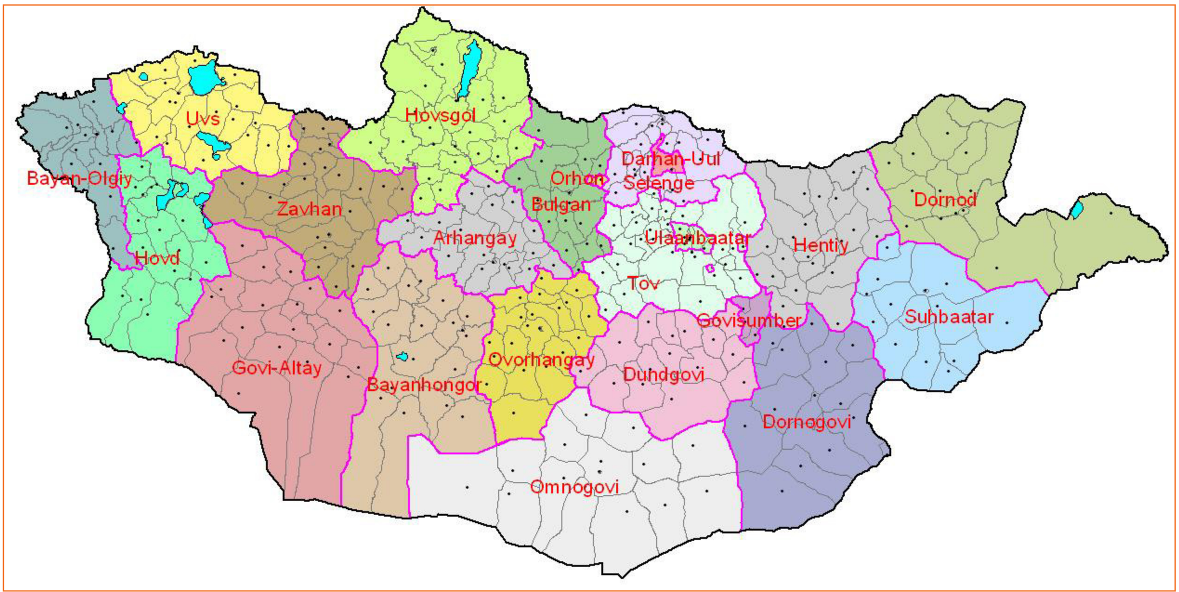

Figure 6. Administrative map

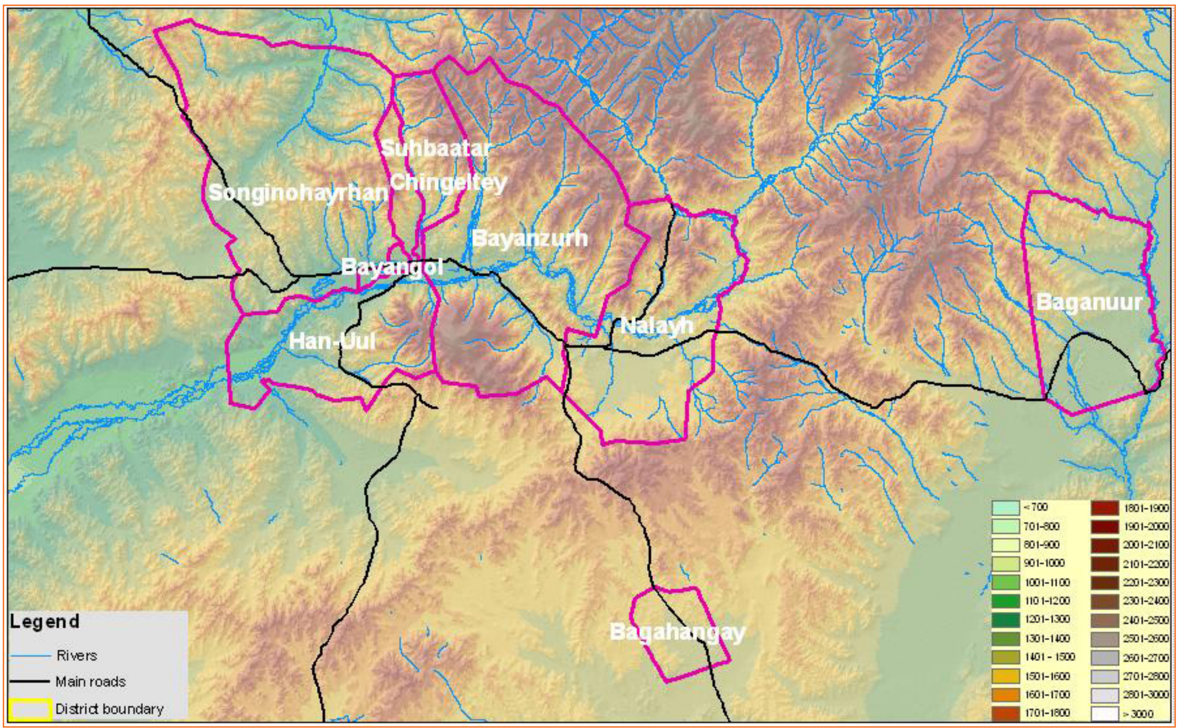

Figure 7. Ulaanbaatar districts

The population of Mongolia is about 2.78 million (2010 census) and the population density is only 1.78 persons per sq. km. The rural population is 36.7% of the total population. A considerable part of the population, more than 1 million, lives in Ulaanbaatar, the capital of Mongolia.

Table 4. Aimag area and population

Nr	Name	Area (km²)	Population, thous (2010)		
			Total	Urban	Rural
1	Arkhangai	55,313.8	91.6	20.2	71.4
2	Bayan-Ulgii	45,704.9	100.8	34.4	66.4
3	Bayankhongor	115,977.8	85.1	28.2	56.9
4	Bulgan	48,733.0	62.6	16.4	46.2
5	Gobi-Altai	141,447.7	58.4	19.0	39.4
6	Dornogobi	109,472.3	59.5	36.1	23.4
7	Dornod	123,597.4	73.6	40.3	33.3
9	Dundgobi	74,690.3	46.3	10.4	35.9
8	Umnugobi	165,380.5	51	17.4	33.6
10	Sukhbaatar	82,287.2	55	14.4	40.6
11	Selenge	41,152.6	106.6	32.0	74.6
12	Tov	74,042.4	90.2	15.7	74.5
13	Uvs	69,585.4	78.2	24.1	54.1
14	Khovd	76,060.4	88.4	29.0	59.4
15	Khuvsgul	100,628.8	124.6	39.1	85.5
16	Khentii	80,325.1	71.8	25.2	46.6
17	Darkhan-Uul	3,275.0	91.7	74.7	17.0
18	Ulaanbaatar	4,704.4	1151.5	1151.5	0.0
19	Orkhon	844.0	85.8	81.2	4.6
20	Gobi-Sumber	5,541.8	13.8	8.6	5.2
21	Zavkhan	82,455.7	76.9	15.7	61.2
22	Uvurkhangai	62,895.3	117.4	27.0	90.4
	Total	1,564,115.8	2780.8	1760.5	1020.3

Source: Statistical Year Book, 2010

The area shown in Table 4 is the official area of the aimags and country.

4.4. Land cover

Maps of the land cover in 1992 and 2002 have been prepared by the Environmental Information Center (EIC) using NDVI (Normalized Difference Vegetation Index) data obtained from the NOAA satellite. The results were estimated land cover types changes in worse direction as, decrease of areas of dry steppe, permanent snow and ice and water body in 28-36 per cents and increase of areas of sand, barren land and desert steppe in 46-64 per cents. The forested area decreased in 8 per cents. The land cover types areas and their changes are giving in Table 5.

A map of the 2006 - 2008 land cover was prepared by the Environmental Information Center (EIC) of the Ministry of Nature and Environment using data from the MODIS satellite which has a 16 times higher resolution. The higher resolution resulted in a change in area of some classes because small areas were added in 2006 which were not identified in 1992 and 2002. E.g. the area of water bodies increased in 2006 because small lakes were added.

Table 5. Land cover types and their changes

Land cover classes	1992	2002	Change (%)
Water bodies	17,470	11,131	-36
Sand, barren land	52,593	76,700	46
Desert	522,938	525,259	0
Desert steppe	155,126	253,936	64
Dry steppe	334,360	240,397	-28
Grassland, steppe	251,261	250,672	0
Forested area	223,904	205,534	-8
Permanent snow, ice	296	204	-31
Total (sq.km)	1,557,948	1,563,833	

Source: EIC 2009

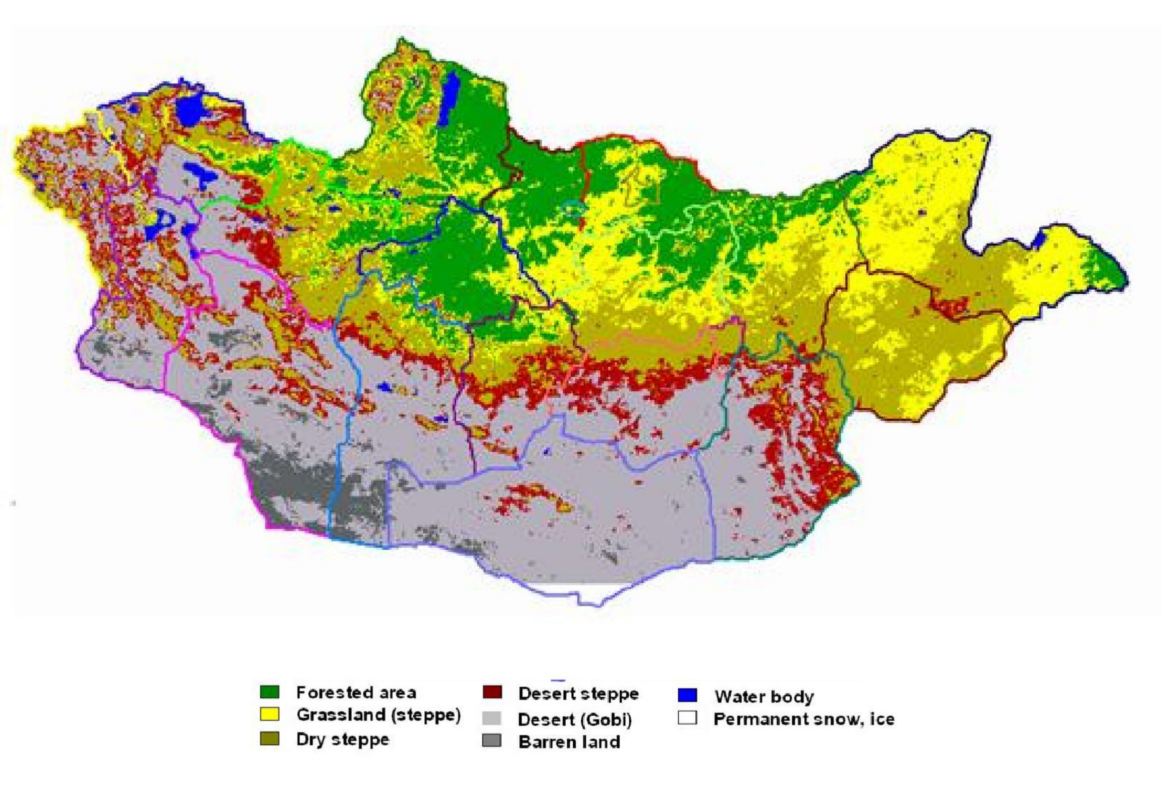

Figure 8. Land cover map 1992

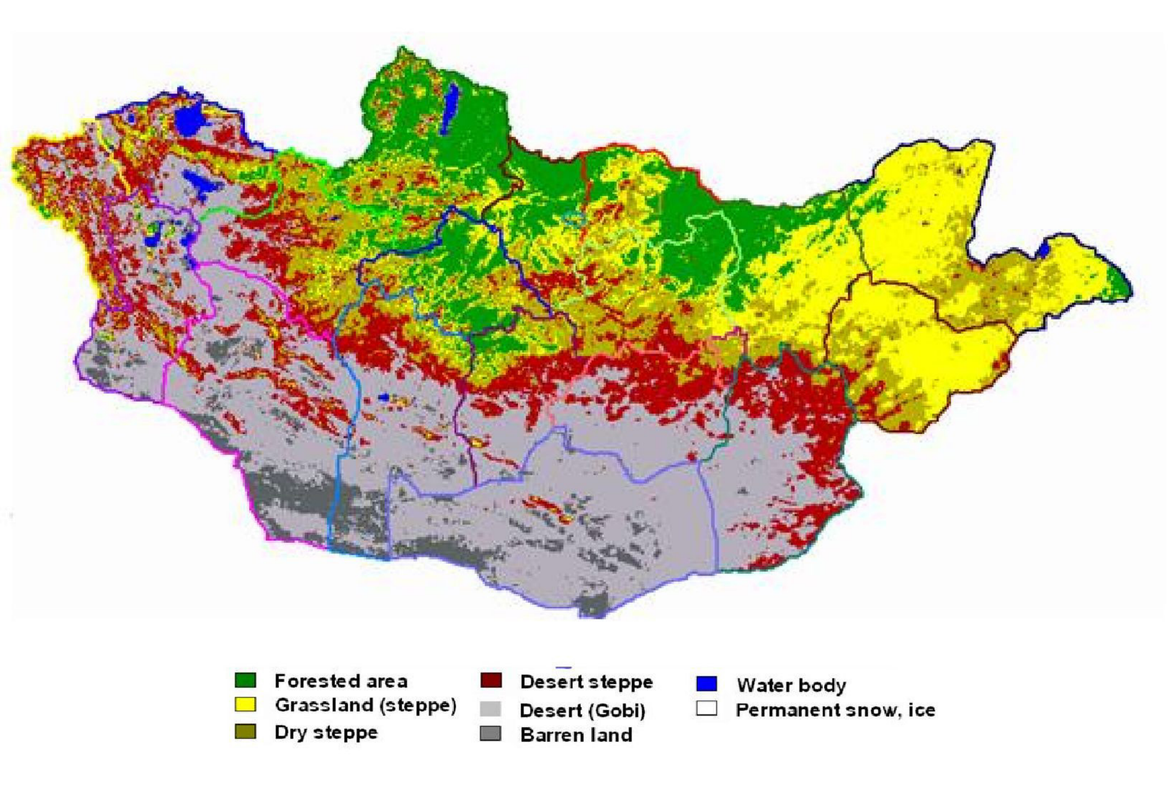

Figure 9. Land cover map 2002

Our country's land surface is extreme and varies from high mountains to undulating steppes and large depressions. The distribution of rainfall and temperature is distinctive. This region in Asia is a place where specific landscape types are formed.

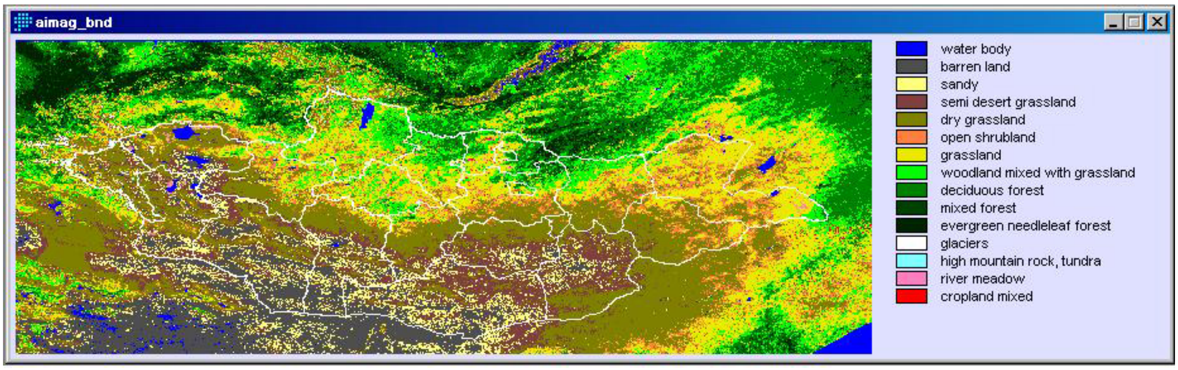

Figure 10. Land cover map 2006/2008

Our country's territory is very wide as it is 1200 km from north to south and the natural condition changes significantly in this direction. Therefore specific landscape features exist at the different latitude zones. The steppe areas are very typical for Mongolia, especially in the northern parts.

But in the mountains in the northern and western half of the country specific zones are formed due to altitude. It makes the latitudinal location of the zones and its features confusing in some way. So, the following zones are distinguished in Mongolian territory. They area: high mountain zone, mountain taiga zone, forest and steppe zone, steppe zone, Gobi zone, and desert zone.

The natural zones map prepared by WWF in 2003 shows the zones according to topography and vegetation (Table 6 and Figure 11). The seven zones distinguished are described below.

Table 6. Natural zones

Nr.	Name of zone	Area (km²)	Percentage, %
1	High mountain	56,308.2	3.6
2	Mountain taiga	67,257.0	4.3
3	Forest steppe	236,181.5	15.1
4	Steppe	534,927.6	34.2
5	Gobi	358,182.5	22.9
6	Desert	298,746.1	19.1
7	Water	12,512.9	0.8
	Total	1,564,115.8	100.0

Source: Biodiversity Assessment, WWF, 2003

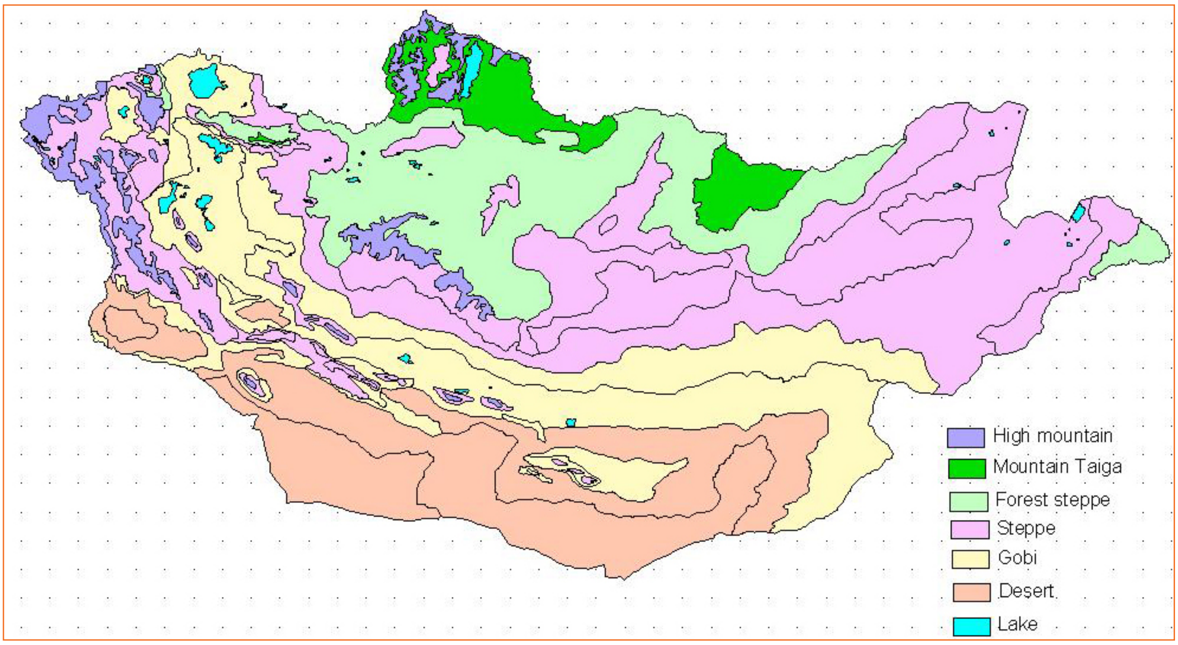

Figure 11. Natural zones

High Mountain zone

This zone is above the tree line, characterized by tundra, alpine- sedge meadows, upland swamps and lichen- covered screes and boulders. Plants include shrubby Ground Birch; occasion Mountain Pine, beautiful white Gentian and Mountain Saxifrage. Typical mammals are "Argali", Ibex, Snow leopard, Ermine, Snow Marten and Mountain Hare, birds include White Ptarmigan, Altai Snow cock, Eurasian Dottrel, Rock Pigeon and Red-Billed Chough.

Mountain Taiga zone

Northern Mongolia includes the southern rim of Siberia's vast taiga forest, the largest forest on the planet Earth. The taiga is boreal coniferous forest, mainly Siberian Larch and in higher areas Siberian Pine. Other conifers such as Siberian Spruce feature. The bark and forest ground are rich in moss, lichens and relatively undisturbed in Mongolia.

Forest steppe

To the south, about 15% of Mongolia is a mix of forest and grassland, a transition zone between taiga forest and steppe, with northern slopes clothed in trees and southern slopes carpets of wild ‘ flower of open grassland'. This attractive landscape has a high biological diversity, home to Roe Deer, Elk, Wolf, Red Fox, and Tolai Hare, Siberian marmot.

Steppe Zone

Further south, the Steppe Zone is a ‘sea grass' covering 34% of Mongolia, crucial for the livestock of the semi-nomadic herder families. These permanent pastures, undisturbed by plough or artificial chemical, are rich carpets of sweet smelling herbs, flower and grasses. The steppe Zone is crucial for the semi-nomadic life on livestock breeding such as horses, sheep, goats, cattle, yaks and camels.

Gobi Zone

To the south lies the vast Gobi, a massive desert straddling the border of Mongolia and the Inner Mongolia region of China. One of the world's great deserts, much of the Gobi is a daunting place of bare Rocky Mountains, sand dunes, huge flat deserts, relieved by well-watered oases. The climate is harsh with temperature of max 40˚C and min -40˚C.

Desert Zone

In the south, again the lush green grasslands of the steppe give away to a transition, the Desert Steppe Zone on the northern rim of the Gobi Desert. The transition zone covers 19% of Mongolia, semi-arid region of parched grasslands and salt pans with strong wind and dust storm. It has grasses and shrubs very different from those of the Steppe Zone and many are unique in Central Asia. In the desert Steppe Zone and the Gobi, there are houbara bustard, cinerous vulture and huge lammergeyer. Grazing animals include herds of wild horse, wild donkey, saiga antelope and black-tailed gazelle.

4.5. Land Use

The table below (Table 7) shows the change in land use since 1986. The 1986 classification was based on the Land Law of 1971. The protected area land classification was deleted from the list after the Land Law changed in 1998 (but was subsequently reintroduced), while the roads and communications classification was newly introduced to the list. The reserve land area was deleted in 2004 from the list of land classes.

As shown in the table, the leading role of agricultural land in the land resources classification has never changed, referring to the tradition and features of the country. The protected area land has changed significantly since 1986, but the increase in protected area land has slowed down since 2005.

Table 7. Land classification types during the past 25 years

nr	Basic classification of land resources	1986		1998		2005		2008		2010	
		Thous. ha	%	Thous. ha	%	Thous. ha	%	Thous. ha	%	Thous. ha	%
1	Agricultural land	128,398	82.1	129,132	82.6	115,274	73.7	115,824	74.1	115,526	73.9
2	Urban, settlements land, mines	474	0.3	376	0.2	469	0.3	530	0.3	620	0.4
3	Protected area land	8,317	5.3	-	-	24,713	15.8	24,793	15.9	24,877	15.9
4	Forest land	14,595	9.3	17,852	11.4	14,703	9.4	14,227	9.1	14,298	9.1
5	Water bodies	1,635	1.1	1,665	1.1	939	0.6	666	0.4	683	0.4

nr	Basic classification of land resources	1986		1998		2005		2008		2010	
		Thous. ha	%	Thous. ha	%	Thous. ha	%	Thous. ha	%	Thous. ha	%
6	Reserve land	2,992	1.9	7,056	4.5	-	-	-	-	-	-
7	Roads and other infrastructure	-	-	330	0.2	313	0.2	371	0.2	407	0.3
	Total area	156,411	100	156,411	100	156,411	100	156,411	100	156,411	100

The land use types of Mongolia are shown in Figure 12. The map presents the spatial distribution of the land use types of Mongolia such as pasture, forest, water etc. The forest area is divided in two types of forest: real green forest (forest) and saxaul forest (forest1). The real green forest is distributed in the northern part of the country and the saxaul forest is distributed in the south part in the Gobi area.

The protected area land is included in the table but is not shown on the map. In fact protected areas are divided into pasture, forest, water bodies and some settlement lands. The location of the protected areas is shown in Figure 29.

The bare land, which consists of sand, rocks, etc. is mainly used for grazing and is included in the agricultural land class because the total area is small.

Source of map: National atlas of Mongolia, 2009

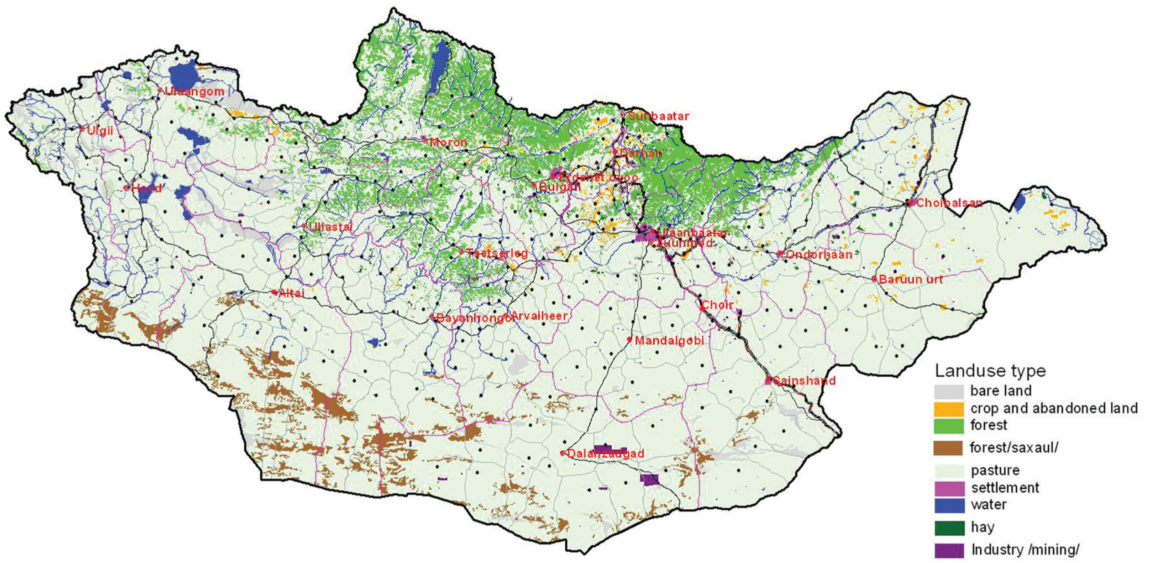

Figure 12. Land use map

4.6. Agricultural Land

Agricultural land in 2010 occupies 73.9% of the whole territory or 115.5 million ha area. Agricultural land includes pasture, haymaking land, crop area, abandoned land, land under agricultural structures and inconvenient land for agricultural use.

The area used for agriculture is shown in the table below for the years 2007 and 2010.

Pasture land occupies the main area in agricultural land. Pasture land is used for natural forage for the nomadic livestock. The reduction in pasture land area is caused by an increase in mining area, by new land ownership to people for spring and winter campgrounds and haymaking. It is further described below.

The haymaking area shows a small reduction in area. Permanent haymaking areas are established to maintain grass growth by irrigation, fertilizing and fencing, while haymaking area ownership is transferred to people and companies in various aimags.

Table 8. Changes in agricultural area (thous. ha.)

№	Category of total land area	2007	2010	Change between 2007-2010
1	Pasture land	111,680	111,256	-229
2	Haymaking area	1,823	1,715	-108
3	Farm land	705	932	96
4	Abandoned land	473	307	-56
5	Land under agricultural structures	52	55	-1
6	Inconvenient land for agricultural use	1,262	1,262	0
	Agricultural area	115,993	115,526	-299

Farm land occupies only 0.8% of the agricultural land. Farm land, abandoned land and land under agricultural structures (livestock buildings, seed and farm produce sheds, etc.) are further described below. Areas under irrigation are also described below.

4.6.1. Pasture Land

Pasture land occupies the main area in agricultural land. The area covered by pasture land is presented in Figure 12.

The pasture land area is decreasing gradually on the long term. The changes during the last 100 years in pasture land area and livestock population are shown in Figure 13. The figure shows a livestock number increase by about 30 million from 1918 to 2004, but a pasture land area decrease by 15 million hectares during this time. The pasture land area per livestock head therefore is decreasing constantly.

Source: Land use in Mongolia, Inception phase report, Baasandorj, 2007

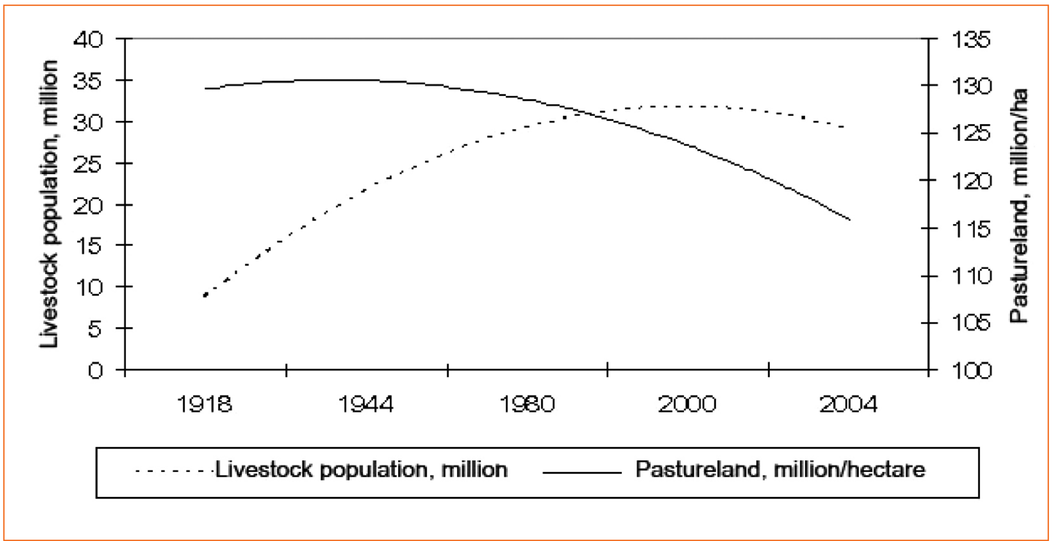

Figure 13. Change in livestock population and pasture land area

Baasandorj, 2007, describes the natural features of the pastureland:

- Vast areas of undulating steppe especially in the central and eastern parts of the country;
- In mountainous areas relief differences make the nutrient and energy cycle unreliable;
- Soils are thin and light with lack of natural fertility;
- About 6.2 million hectare of total pastureland is covered by bluffs and 2.2 million hectare area covered by saline soils of arid desert;
- Vegetation cover is very sparse and average yield of pasture is estimated about 2.8 centres per hectare.
- Climate features are dry and cool, low precipitation, not equable allocation, short period of snow cover and deep freeze of soil in winter;
- Maximum arid period of soil and air overlaps with poor plant growth period. Wind blows frequently because of large variations in day and seasonal temperatures.

The features in pastureland use are:

- Pastureland is used by a community based system inside public and other institutions;
- There is no allocation for each type of livestock and can pasture any animal;
- Herders have no limit or border to take their livestock to any suitable pasture;
- The tax of pastureland use is estimated by the livestock type and population not by the size of pastureland area;
- There is no certain provision on pastureland protection, restoration and rehabilitation of soil and plant cover;
- Sometimes livestock graze in cropland and it becomes pastureland;
- The traditional policy of livestock leading pasture still could not adjust the livestock population into specific features of the pastureland.

Davaadorj, 2010, describes that about 19.2 million ha of pasture should be considered degraded and desertified which means that about 92.2 million ha was available in 2008 for livestock grazing. Considering the 43.2 million animals in 2008 (converted to sheep head 67.9 million) normal grazing capacity is already reached. However pasture grazing is not the same everywhere. In some soums of Dornod and Khentii aimags pasture grazing is around 48-52 percent. Nearby population settlements the number of animals exceeds 3 to 5 times the permissible number, causing land degradation and impossibility of grass regrowth. Furthermore, pasture grazing is unsatisfactory in remote Khangai Mountain areas due to water shortages and no roads.

If the pasture degradation process continues then about 70 percent of the total pasture land can become impossible to graze and special policies will be required to realize pasture exploitation management. This pasture management should include:

- Abandon the pasture for years;
- Regard to traditional animal pasturing by grazing the pasture with a 4 season schedule and in the summer in one place the animals should not be grazed more than 14 days;
- Legislation on pasture exploitation near cities and settlements where the land is given to people on a long term contract base only for intensive and settled livestock keeping;

- Law, regulation and realization on long term joint use by group herders of parts of pasture remote from settled localities;
- To be controlled the number and animal species according to annual determination of the pasture grazing capacity and possibilities.

All the above should provide the conditions to permit the production of year around pasture livestock products and should lead to less land degradation.

A more detailed description of pasture types and biomass changes is included in Annex 1.

4.6.2. Farm Land

Davaadorj, 2010, describes that according to the Mongolian and Soviet Union 1968 joint expedition studies 1.743 million ha is suitable for farming. In total 1.34 million ha was used as farm land belonging to 52 state owned farms, 17 feed farms, 255 state adjusted and managed cooperatives with mixed properties; 17 cooperative joint ventures and 15 joint cooperatives.

Every year the state farms fallowed one third of their farm area for moisture accumulation and weed killing and as a result harvested fixed yields of cereals each year. During the transition to market economy no state investments were made and production activities reduced from year to year. In 2005 an area of 150 thousand ha was cultivated and 77 thousand tons of cereal grains were harvested.

The statistics of 2008 show that only an area of just 475 thousand ha remains under stable farming of the whole 1.7 million ha cropping available area in Mongolia. An area of 380 thousand ha seems to be abandoned, but in reality an area of 750 thousand ha is abandoned and not used for 5-18 years.

The 2008 cropping area increased by 131.6 thousands ha compared with the previous year. According to the "Virgin-III" program announced by the Mongolian Government, the farming area increased in all aimags.

In total 22.0 thousand ha of virgin land was granted out to people and other organizations for agricultural purposes in accordance with article 2.4 point 6 of the Law on Agriculture, which points out to grant to citizens of Mongolia for their family needs up to 30 ha land for irrigation of potato, vegetables, and fruits, for irrigation of forage crops up to 100 ha land near water sources.

Table 9. Classification of agricultural farm land (ha.)

№	Category of total land area	2007	2008	2010
1	Cereal crop planted area	157,265.8	183,903.3	308,028.1
2	Potato and vegetables planted area	24,235.4	27,016.4	29,818.4
3	Forage planted area	42,836.5	19,172.2	22,234.0
4	Oil crop and fruits planted area	1,963.7	18,201.9	8,622.6
5	Fallowed area	145,845.7	226,630.9	259,462.6
6	Non cropped area	332,348.0	360,804.6	304,254.8
7	Agricultural area	704,495.1	835,729.3	932,420.3

As a result of action by the aimags' and capital city's land department the agricultural area increased for each classification except forage planting due to the improvement of the farm field use, of the ownership to people and organizations to reuse abandoned area and of the reapportioning of the farming agricultural area, according to the announcement of the "Virgin-III" program by the Government in 2008. The variation in the used agricultural area is shown in Figure 14.

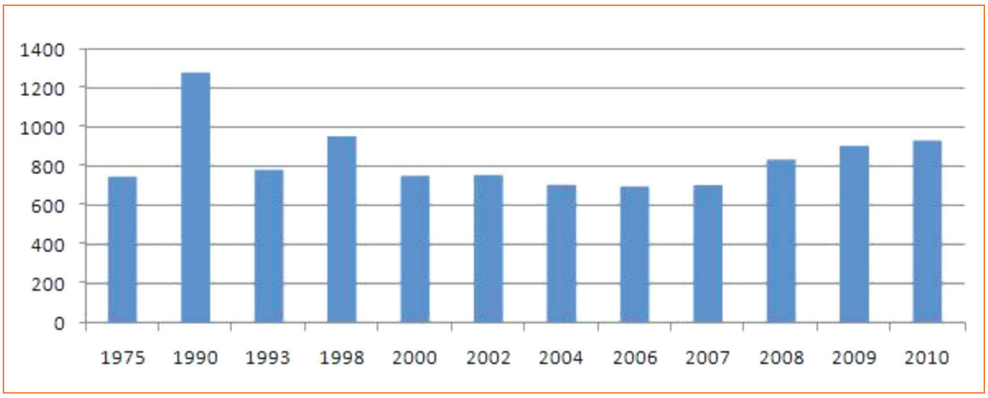

Figure 14. Agricultural area 1975 – 2010 (thousand ha.)

4.6.3. Abandoned land

The abandoned land area increased from 1990, but decreased in the last few years. Within the activities of the above mentioned program the abandoned agricultural area reduced in 14 aimags of the country mainly due to ownership for refarming and due to confiscation and redistribution of land ownership to companies and organizations, if used not properly and abandoned more than two years and no land payment in time.

The abandoned agricultural area is shown in Figure 15.

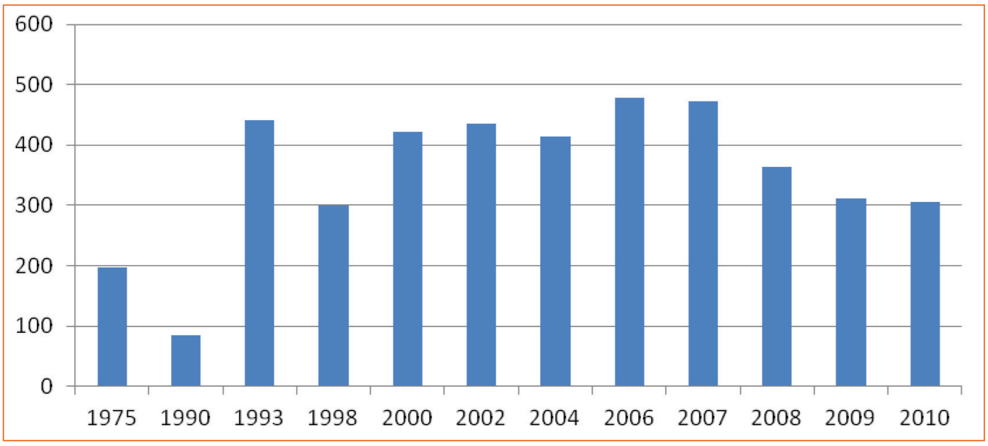

Figure 15. Abandoned agricultural area 1975 – 2010 (thousand ha.)

4.6.4. Area under agricultural structures

To compare last 5 year's data the area under agricultural structures (livestock buildings, seed and farm produce sheds, etc.) increased. To this category belong areas at spring and winter campgrounds, because of new ownership to people for spring and winter campgrounds. At the same time, activities on ownership and certification of summer and winter campgrounds' have been organized to herders in aimags.

4.6.5. Irrigation areas

In the socialist time 482 irrigation systems were constructed with a capacity to irrigate 91.6 thousand ha crop area; 156 of them or 49.5 thousand ha crop area were constructed with government investments for irrigation and 326 small one's for irrigating 42.1 thousand ha crop area involved local investments.

According the water department of the Ministry of Food, Agriculture and Light Industry; the agricultural area under irrigation may reach 68 thousand ha by 2013 to realize the goal in the Government Program to increase the areas under irrigation by 31 thousand ha between 2008 and 2012.

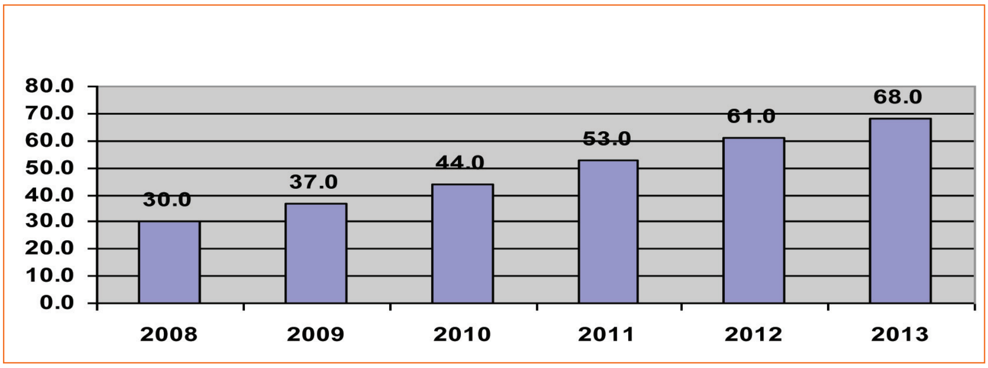

Figure 16. Area under irrigation 2008 - 2013 (thousand ha.)

Table 10. Irrigation land changes (thous. ha)

Year	Total planted land	from					
		Grain	Potato	Vegetable	Fruit	Fodder	Other
2000	5,585.45	3,631.5	330.0	708.25	153.0	746.7	16.0
2008	29,596.58	7,388.2	8,844.6	5,682.8	5,023.7	1,843.8	813.5
2010	36,993.5	9,428.3	9,953.9	6,130.7	3,766.5	589.3	7,698.3

Source: report of Water division of Ministry of Food, Agriculture and Light Industry

4.7. Vegetation

The land cover of Mongolia is divided into two basic types, viz., high mountains and steppes and the vegetation of Mongolia is associated with this (Figure 17 and Table 11). In the mountainous region in the north the Altai, Khangai, and Khentii Mountains have cedar and larch forests, while in the south the Mongolian Altai and Gobi Altai Mountains are rich in bluffs and have more bushy vegetation.

The vegetation of Mongolia contains plants of 2 large florist regions: the Siberian taiga in the north and the Central Asian steppe-desert in the south. The basic vegetation form in the taiga belt is cedar and larch forests. The prevailing types of steppe plants are various kinds of Faether grass; Miscanthus, Artemisia and Potentilla. Most important in Mongolia's desert are Piptanthus Mongolicus Maxim, Convolvulus Gorchacowa and Oxytrpic.

Source: ICC-NGIC

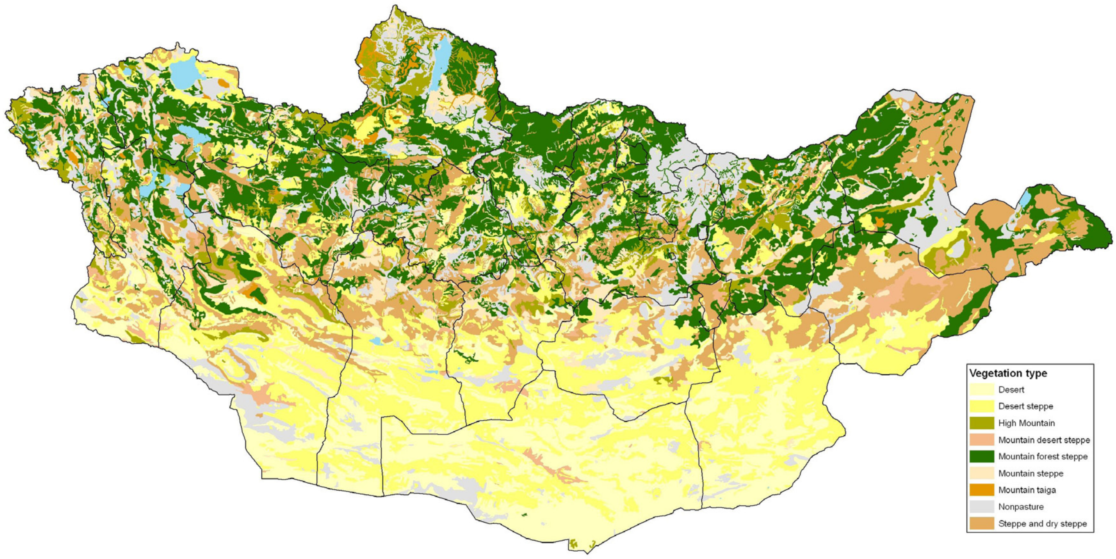

Figure 17. Vegetation Map

Table 11. Vegetation type

Vegetation type	Area, км^2	Percentage
High mountain	71,949.3	4.6
Mountain taiga	12,512.9	0.8
Mountain forest steppe	331,592.5	21.2
Mountain steppe	84,462.3	5.4
Mountain desert steppe	26,590.0	1.7
Steppe and dry steppe	245,566.2	15.7
Desert	251,822.6	16.1
Desert steppe	339,413.1	21.7
No grass	200,206.8	12.8
Total	1,564,115.8	100.0

The natural pasture land can be divided into 200 types of pasture and 900 of the total 2800 plant species that are listed in Mongolia are vascular plants and are used for livestock forage. Since Mongolia is located between the Siberian taiga in the north and the Gobi Desert in the south, the pasture vegetation decreases from north to south.

At present, the vegetation of Mongolia comprises 2,251 species of higher vascular plant united in 596 genus and 103 families; 293 species of mosses united in 119 genus and 40 families; 570 species of lichens united in 70 genus and 30 families; 218 species of tungi united in 34 genus and 12 families; and 574 species of algae united in 154 genus, 52 families 8 types. The largest ones among the higher vascular plants are families of Compositae, Leguminosae Juss, Grami Naseous, Miscanthus, Suaeda Glauca Bunge, Dianthus and Scrophularia incisa weinm.

Mongolia has abundant medicinal plants and 700 species are used for traditional medicine. Generally the flowers and leaves of medicinal plants should be gathered in July and September and their roots from October to the spring of the next year.

4.8. Soil

There are many different natural zones in Mongolia. Also there are big differences in elevation. The territory is generally elevated above sea level.

Due to these differences, the distribution of soils, its origins and its features is uneven. Due to the geographical location of the country, it stretches from the northern Siberian permafrost taiga to the Central Asian dry desert. It is far from the ocean and climate is extreme continental. There are valleys, steppes and mountains.

The soil map presented in Figure 18 is one of the maps developed by 1980 Mongolian and Russian experts using aero photo maps and satellite data. This map for Mongolian soil types and distribution is at scale 1:1,000,000. The map shows 220 types of soils. The area and percentage of area is presented in Table 12.

source: ICC-NGIC

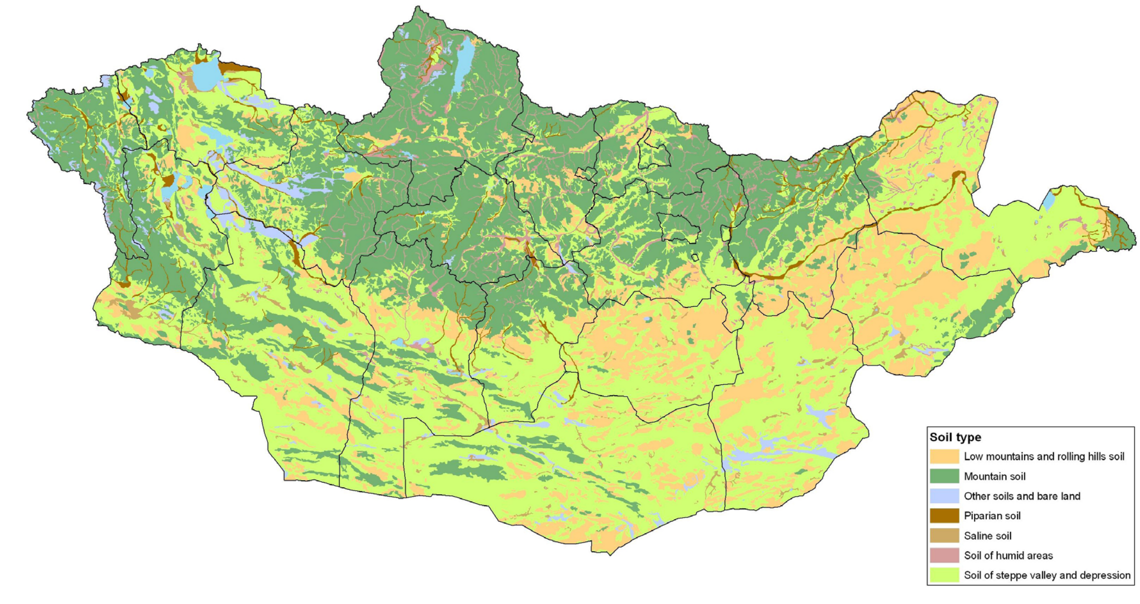

Figure 18. Soil Map

During 1990's academician D.Dorjgotov elaborated a new classification and classified soil into 2 groups, mountainous and steppe. These soil groups are different from one another in terms of geomorphologic condition and soil forming process. The physical features and characteristics of the main soil types and subtypes of Mongolia are described in Annex 2.

Table 12. Soil type

Soil type	Area, км²	Percentage
Low mountains and rolling hills soil	265,899.7	17.0
Mountain soil	517,722.3	33.1
Other soils and bare land	51,615.8	3.3
Riparian soil	28,154.1	1.8
Saline soil	23,461.7	1.5
Soil of humid areas	45,359.4	2.9
Soil of steppe valley and depression	631,902.8	40.4
Total	1,564,115.8	100.0

4.9. Soil erosion and degradation of pasture land

Due to climate change, the number of dust storm days and the frequency of droughts and dzuds (severe winters) have increased in recent years. Together with abandoning the traditional use of pasture and the increasing pressure on land use for different purposes, plant cover degradation and soil erosion are on the rise.

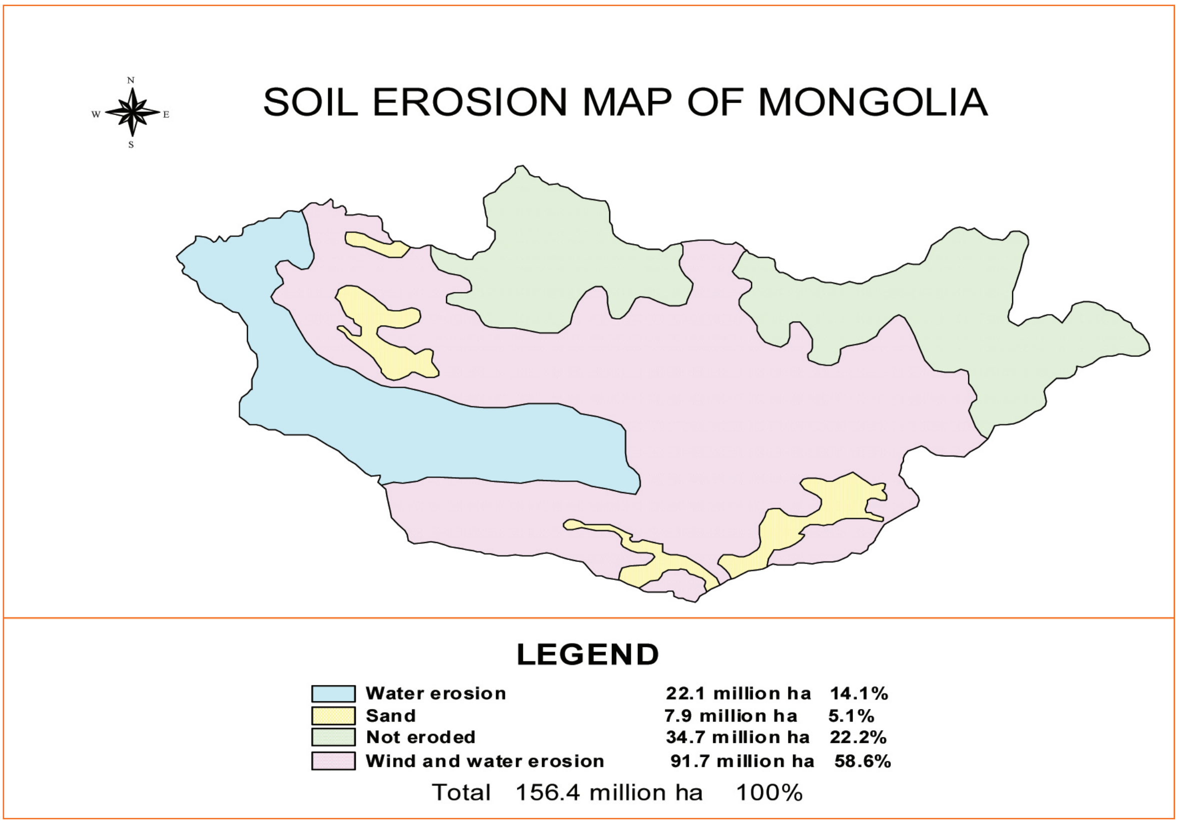

Figure 19. Soil erosion map of Mongolia (1996)

Based on the natural zones, land exploitation and soil map, a soil erosion map of the Mongolian pasture land was developed in 1996. It is estimated that 78.8% of pasture territory was eroded. Of the eroded land, 58.6% was caused by wind and water, 14.1% by water alone, and 5.1% by wind alone.

Until the middle of the last century land in Mongolia was used almost only for pasture purposes. However, from the middle of the last century, land became used for different purposes and land degradation increased dramatically. Therefore, pasture degradation and soil erosion is abundant throughout the pastureland of Mongolia and only few places that have been not affected are left in the Eastern Mongolian steppe.

By the pasture monitoring studies in 2000-2005, 17.2% of pasture land is overgrazed. Pasture degradation is mostly in the steppe zone, along river valleys and around settlement areas. Soil erosion and pasture degradation maps are shown in Figure 20, Figure 21 and Figure 22.

Annex 1 contains some more information on soil erosion derived from studies by GEI.

Source: National atlas of Mongolia, 2009

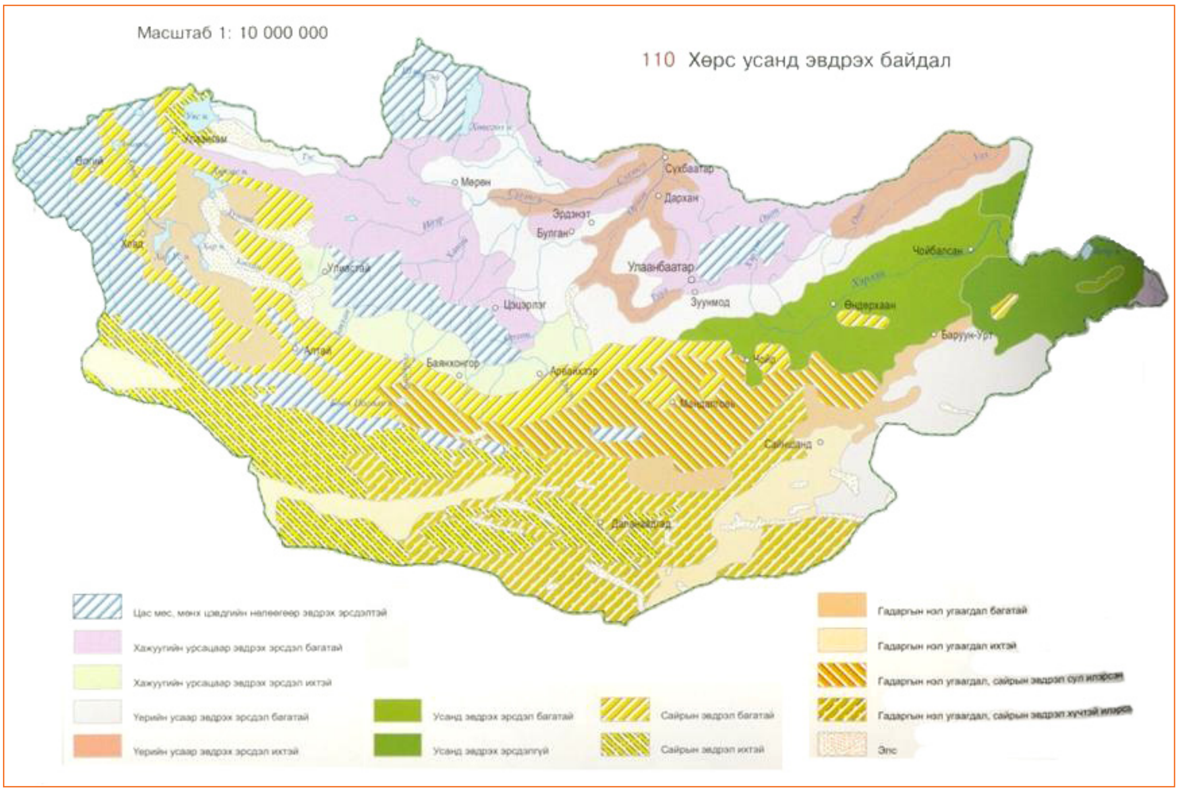

Figure 20. Soil Erosion by water

Source: National atlas of Mongolia, 2009

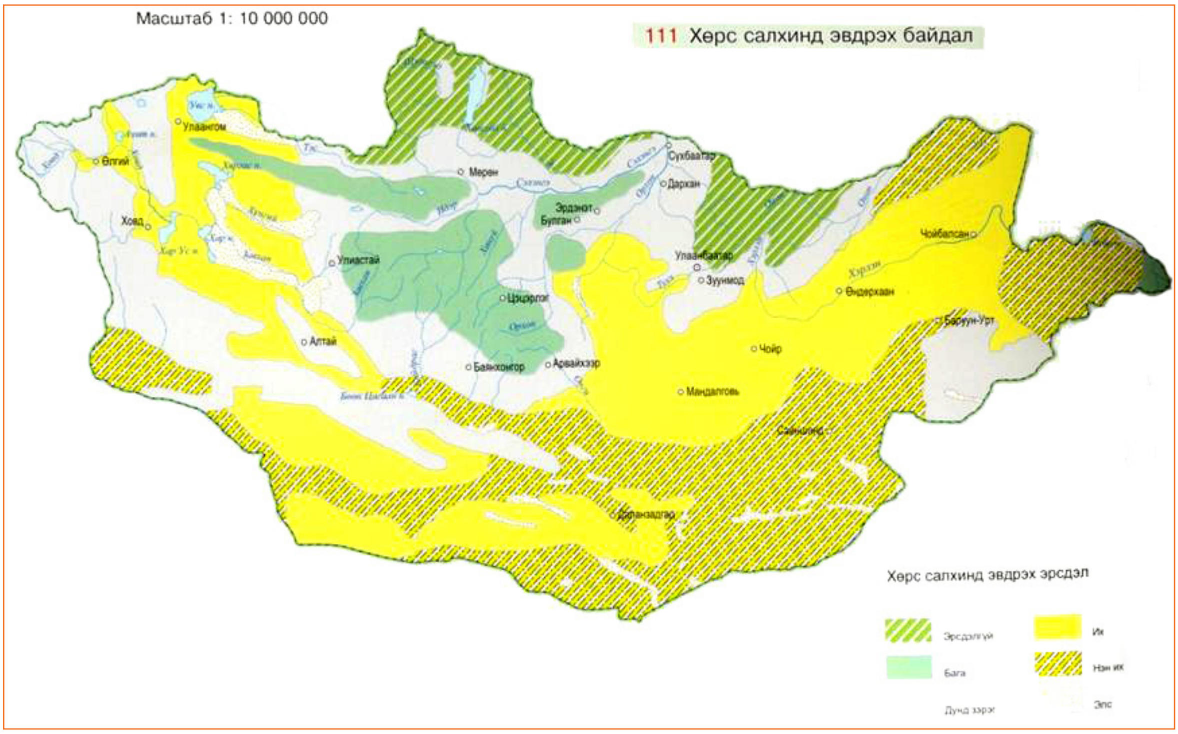

Figure 21. Soil Erosion by wind

Source: National atlas of Mongolia, 2009

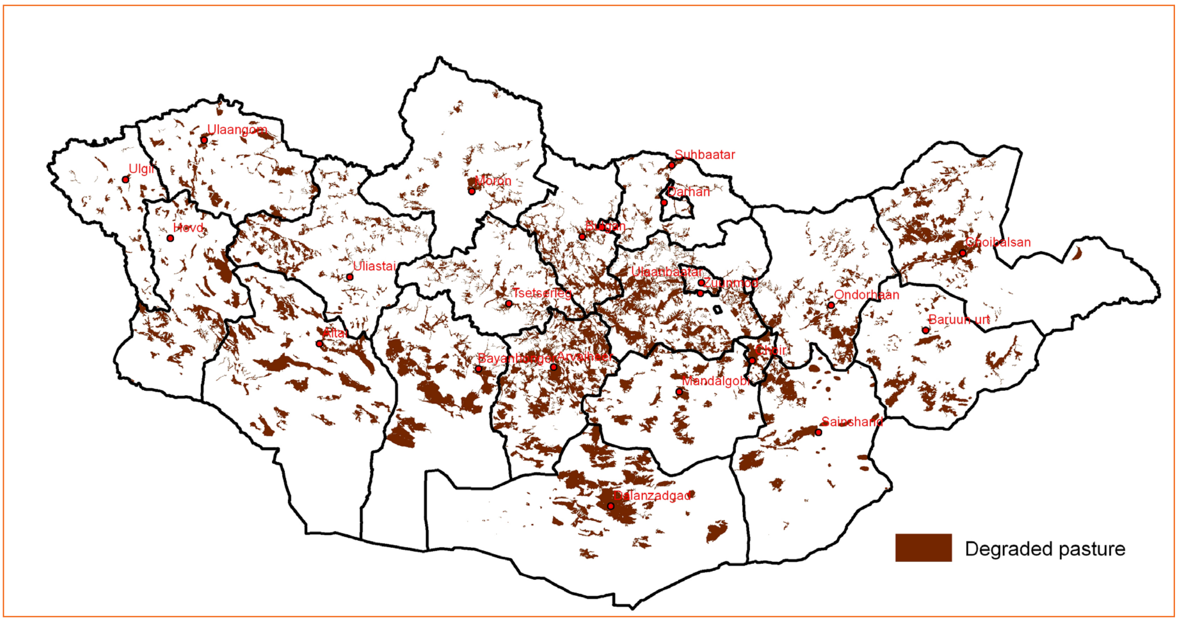

Figure 22. Pasture degradation map

4.10. Desertification

Factors causing desertification can be classified into natural and human, as well as into permanent and changeable. In other words, natural and human factors are closely interlinked resulting in different patterns of influence while depending on their spatial distribution and temporal variation. Biophysical and socio-economic factors are interlinked and understanding the pattern of their coincided effect is necessary to objectively assess the process of land degradation.

The following natural factors are relevant in Mongolia leading to land degradation and desertification:

- Remote location from ocean and sea causing dry and harsh climate conditions;
- Surrounding mountain ranges (Mongol Altai, Gobi Altai, Khuvsgul, Khentii) prevent spread of humid air coming from the west resulting in dry climatic conditions;
- Low rate of precipitation, mainly occurring in summer, increases the occurrence of successive drought;
- Increase of days with dry and strong winds in spring period.

These factors related to the specific geographic location of the country basically define that the area is naturally sensitive to any disturbances. L.Janchivdorj conducted research on regional differences in humidity index, which inferred that 72.8% of the territory is vulnerable to desertification of which 59.4% or 929.6 thousand km^2 are highly vulnerable.

Researchers have shown that the following natural processes occur in Mongolia:

- As a result of climate change and drought occurring in the last decade springs, small rivers and wetlands dried out resulting in ecosystem deterioration and becoming the first indicators of desertification;

- Decrease of soil water content resulting in loss of vegetation cover and decrease of yield is causing the vegetation cover to deteriorate overall;
- Drying of rivers and lakes resulting in decrease of water balance;
- Drought is affecting wetland ecosystems with huge ecosystem changes occurring as a consequence;
- Forests are deterioration under the influence of forest pest insect distribution which disturbs the water regulation capacity at watershed level and results in changes in river flow.

As for human factors the following factors play a major role:

- mismanagement of grassland resource use;
- inappropriate technology applied in agriculture, especially in irrigated agriculture practices;
- fuel wood collection;
- technogenic deterioration of land through urban development, mining and unpaved road construction;
- mismanagement in water resource use, especially near the source of springs, rivers and so on;
- use of pesticides in agriculture.

In natural factors the climatic factor plays a major role, which is mainly determined by drought events occurring in the region. In the case of desertification assessment the air temperature and the precipitation are used as indicators.

Scientists assume that the climatic change occurring in Mongolia is influenced by the global warming effect, for instance, from the 19th Century until now, the global air temperature increased by 0.6 degree Celsius. Within this change, according to the last 60 years of observation data, the mean air temperature in Mongolian increased by 1.56 degree Celsius. The seasonal change is significant in the country, for example, the mean air temperature in winter increased by 3.6 degrees whereas the summer temperature decreased by 0.1 degrees.

In the period 1940-2003 the sum of the effective precipitation during the vegetative period decreased by 13.8 mm or 7.2%. In eastern and western Mongolia the sum of the effective precipitation during the vegetative period increased by 2.7-9.5%. In the central and Gobi part of the country it decreased by more than 10%. Summer rain in the Central and Gobi part of the country decreased by 17.0 mm, 13.0 mm, respectively, and in Western, Eastern parts increased by 3.3 mm, 21.4 mm, respectively.

According to the results of drought index estimation on a nation-wide level, using 40 years data collected from 180 stations, the warming process tends to be more active in the central and eastern part of Mongolia. However, the warming process does not seem to take place in western Mongolia, especially in the arid regions of Djungarian Gobi and in the southern parts of Sukhbaatar (Figure 23).

Source: Zolotokrilin, 2005

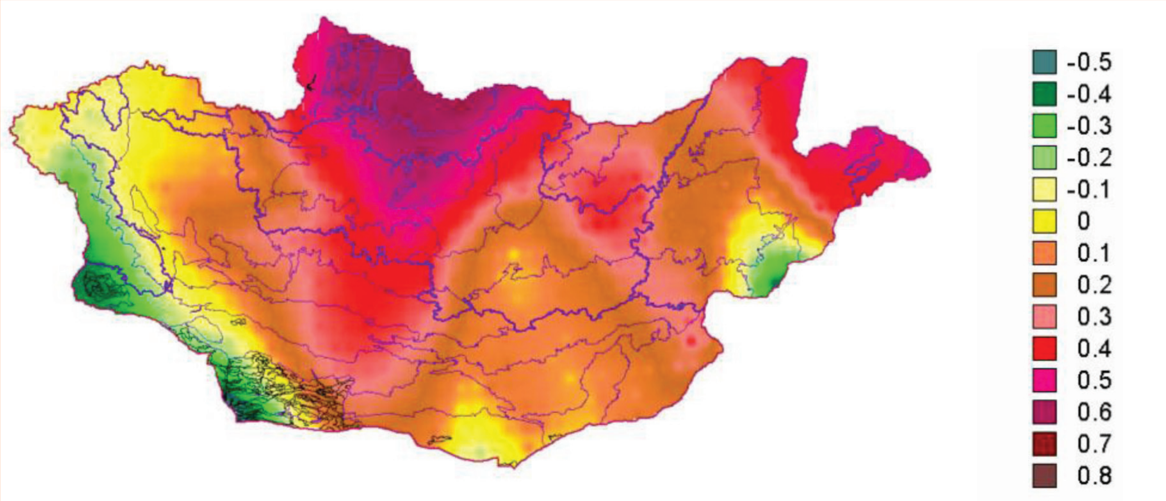

Figure 23. Extent of warming in Mongolia, change in ˚C

One of the useful indicators to assess the state of desertification is the barren soil cover. The spatial distribution and the temporal changes of bare soils have been investigated by researchers S.N.Baja, M.Bayasgalan and A.N.Zolotokrilin. They studied the effect of climatic factors on the vegetation cover using the normalized difference of vegetation index (NDVI) and the Palmer drought index. According to the research, territories with NDVI less than 0.05 are considered as bare soil. The bare soils have been assessed for the period of spring-summer of each year. The results of the remote sensing investigation shows that the bare soil area has increased by 15% in comparison with 1994 (Figure 24).

Source: Bayasgalan, 2004

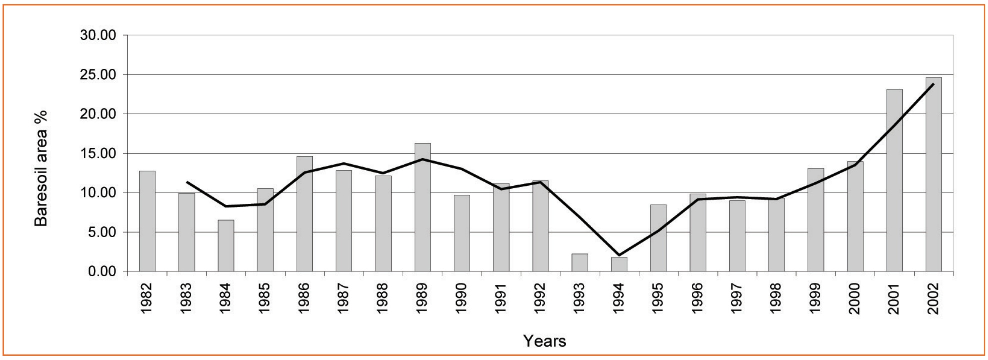

Figure 24. Dynamics of the bare soil area within 1982-2002

The bare soil area has expanded to the north by 30-40 km in the southern parts of Mongolia and in the western parts of the country, namely in the Great Lake Valley has increased by 8.1%. Investigation on factors determined such a rapid change of vegetation cover shows that it is closely related with drought fluctuations during the last decade. Moreover, the negative influence of pasture use has serious impact on the dryland ecosystem of the country.

According to the results of the research conducted by Dr.M.Bayasgalan territories with bare soil tend to increase proving that the territory of desertified land is expanding. Naturally, bare soils correspond to the desert and sandy lands but during the last 20 years the trend of NDVI shows its expansion over the large territories surrounding the deserts.

The results of correlating NDVI and Drought Index conducted by A.N.Zolotokrilin, N.S.Baja indicated that deterioration of vegetation cover by climate warming is feasible in transition zones such as forest steppe, steppe, and Gobi steppes. The research proved that a complex of natural factors with a major role by climatic drivers has a serious impact on central and northern parts of the country.

During the last half century the human interaction on the fragile Gobi steppe ecosystem has increased land degradation as well as desertification due various causes, such as: the loss of traditional ways of pasture utilization, the heavy machinery use in the agricultural sector, the development of many auto road branches and inappropriate technologies by mining industries. Due to the above mentioned climatic and human factors about 70% of the rangeland has degraded [Biodiversity report, 1998]. It is noticeable, that the average pastureland yield decreased by 20-30% during the last 40 years [Bolortsetseg, 2002] and that the vulnerability of animal husbandry to the drought and dzuds (extreme winter) in the country has increased [Natsagdorj, Sarantuya, 2003].

Desertification is a complex process closely related with climatic, geomorphologic, soil and vegetation cover processes. Nowadays, it can be assumed that the determination and assessment of the natural indicators of desertification in Mongolia is well developed.

Table 13. Desertification dynamics during 1990-2006

Level of desertification %	1990	2000	2006
Slightly desertified territories	76.0	34.9	26.7
Moderately desertified territories	20.0	38.7	35
Severely desertified territories	3.0	16.1	22.5
Very severely desertified territories	1.0	1.8	7.3
Extra arid desert region	-	8.5	8.5

Source: Desertification research center, Institute of Geoecology

Source: Desertification research center, Institute of Geoecology

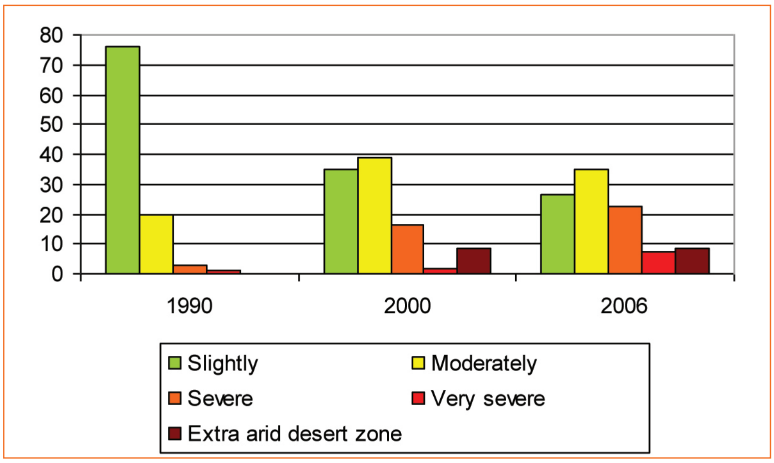

Figure 25. Desertification trend

Source: ISEAM, TACIS Project, MNE

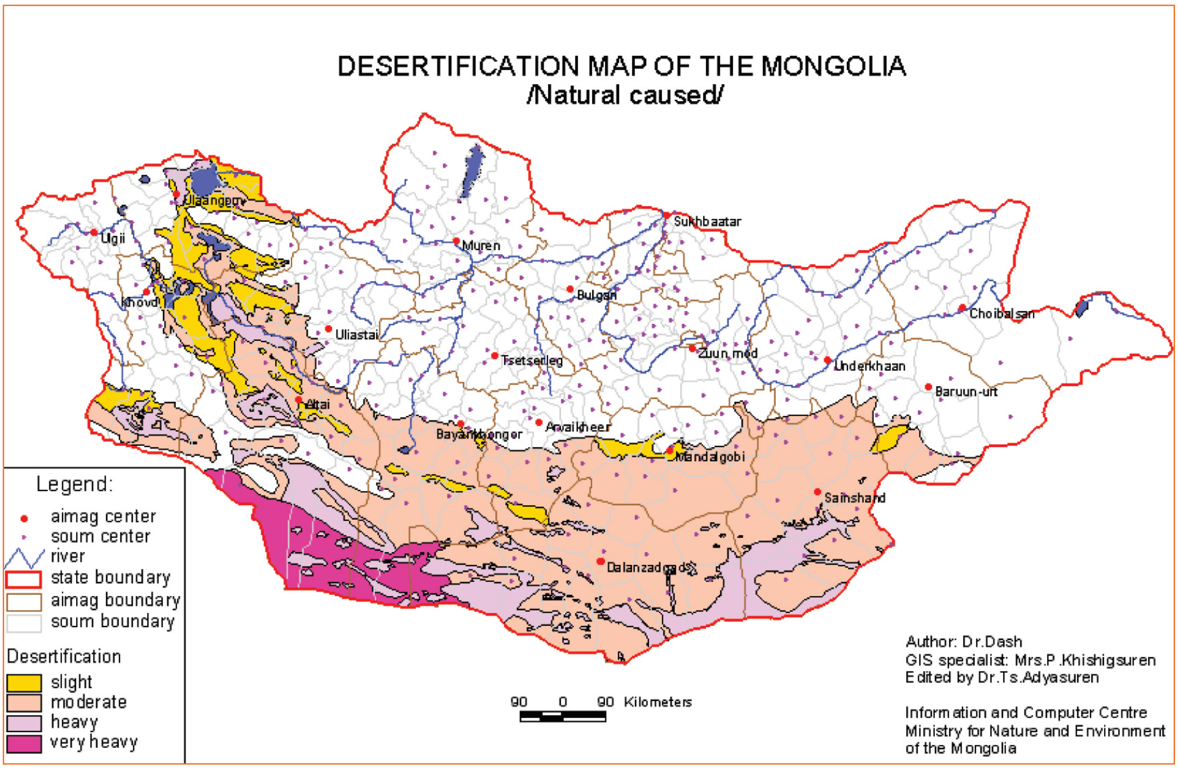

Figure 26. Desertification Map 1990

Source: ISEAM, TACIS Project, MNE

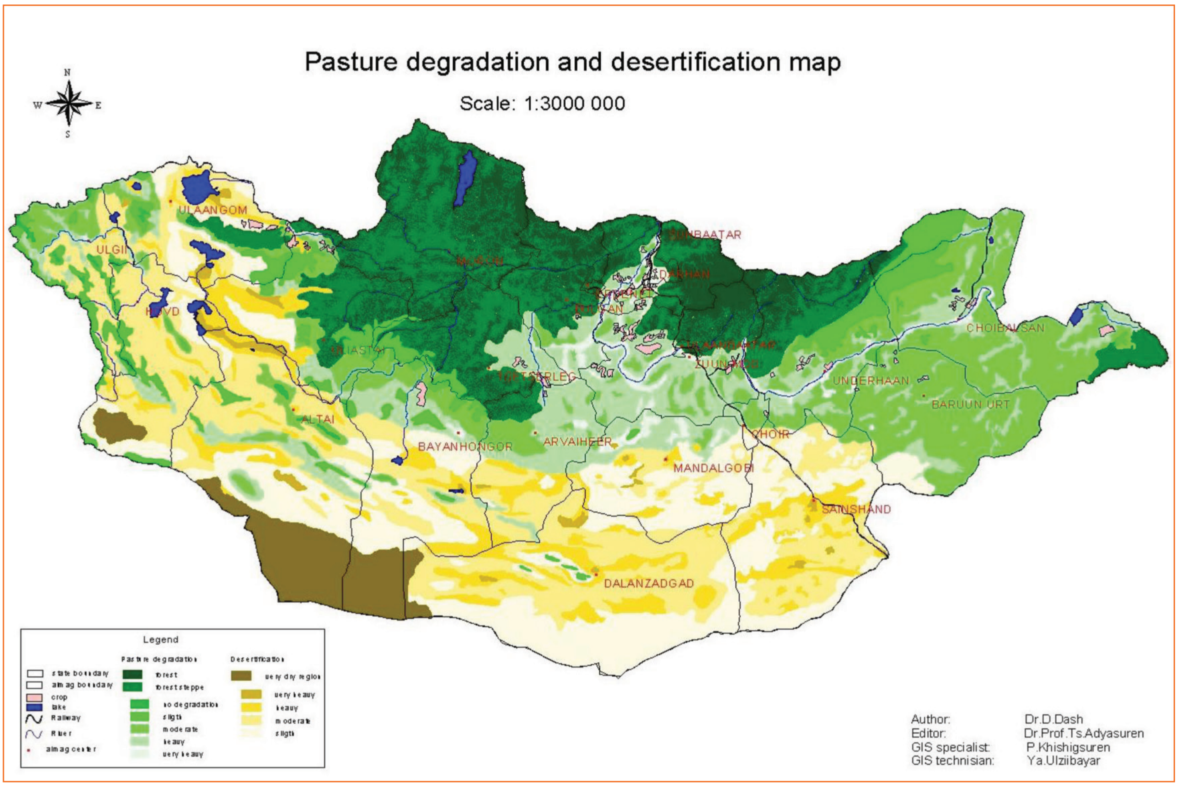

Figure 27. Desertification Map 2000

Source: Institute of Geoecology, MAS

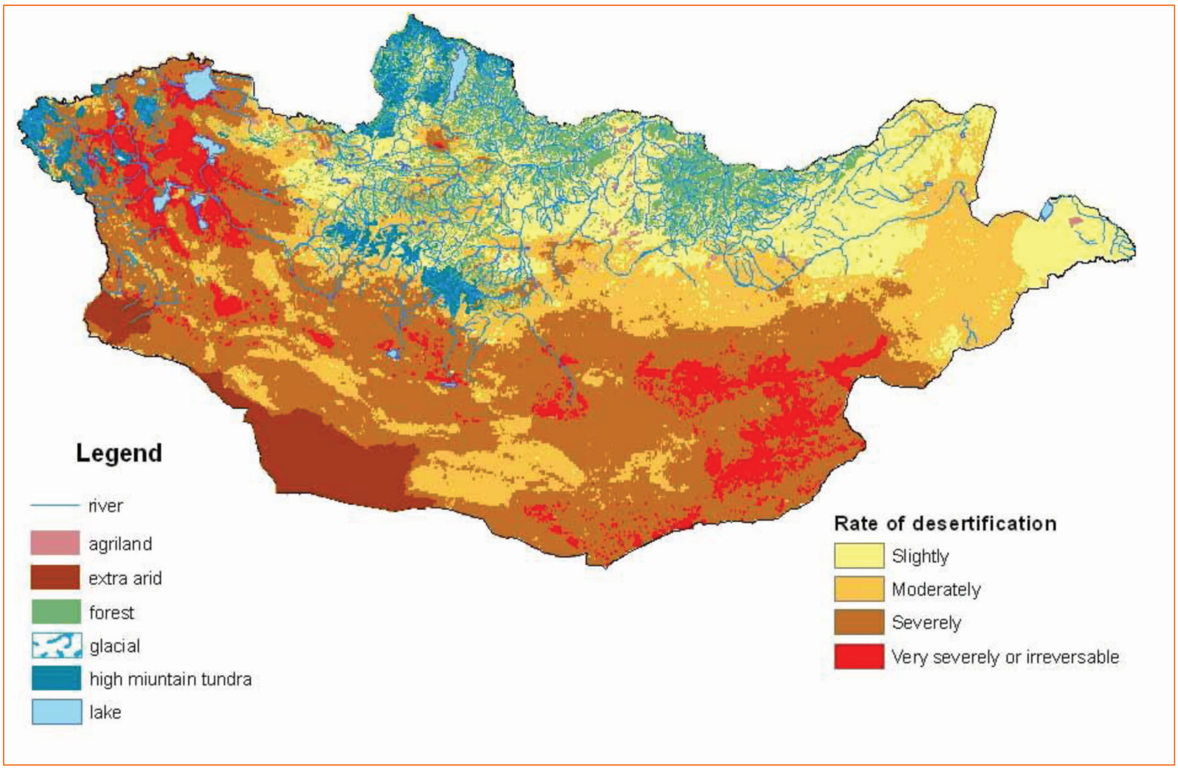

Figure 28. Desertification Map 2008

4.11. Protected areas

So-called specially protected areas are established in Mongolia to protect the specific natural conditions in exceptional areas. There are in total 61 protected areas of four different types (*Figure 29*):

- 18 Strictly protected areas: an area taken under special protection of the State in order to ensure the ecological balance for peculiar features of natural zone and belt, its state of originality and outstanding scientific significance;
- 24 National parks: an area taken under special protection of the State which has relatively conserved its natural original state and importance for historical, cultural and scientific knowledge, ecological education;
- 21 Natural reserves: an area taken under the state special protection to protect certain type of nature to protect and conserve any resource and to facilitate reclamation;
- 8 Natural historical monuments: an area which is taken under the special protection of the state to preserve the unique natural formations, historical and cultural traces in their original conditions.

Information on the protected areas is provided in Annex 3.

In addition eleven areas are registered as Ramsar site. These are wetlands with an international importance registered under the Ramsar Convention. Information on these sites is also included in Annex 3.

The protected areas cover 14.4% of Mongolia in 2010. Plans exist to extend this area to 30% by 2015.

Source: NGIC Database

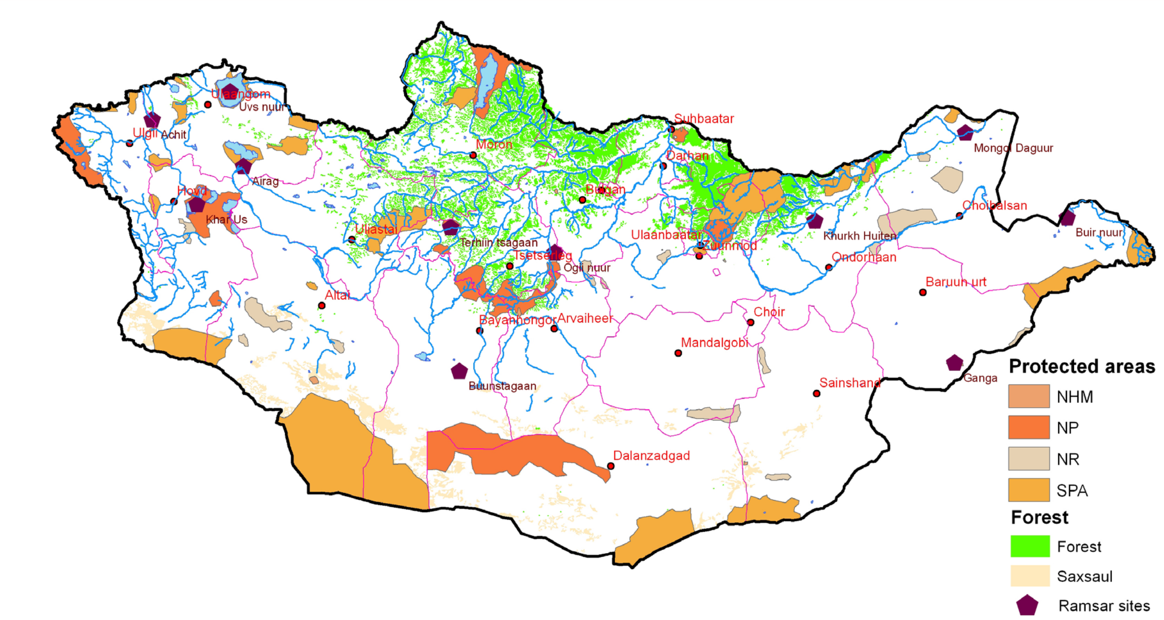

Figure 29. Protected areas and Ramsar sites

4.12. Forest land

The forest land of Mongolia occupies more than 9 percent of its area and it is an important natural ecosystem that protects from soil erosion, keeps ecological balance and regulates the water resources, stores greenhouse gases, provides a beneficial condition for microorganisms and holds the permafrost.

During the last 30 years, the rate of deforestation increased by 1.0 million hectare and about 350 thousand hectare of forest is affected by fire annually and 110 thousand hectare of forest is infected by insects. In addition, natural growth of forest is slow and researchers indicate that forest plants are changing to steppe plant composition. It is estimated that because of wood cutting 250 thousand hectare of forest area lost its regenerating process and 160 thousand hectare of forest area is changed to steppe and covered by sand.

Source: NGIC Database

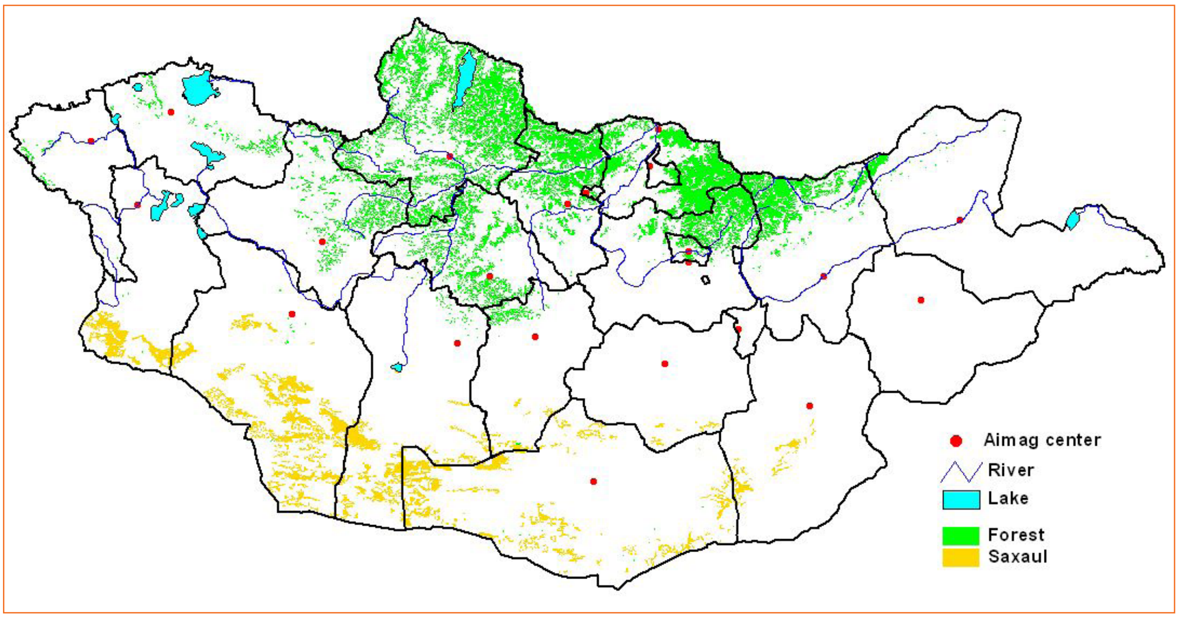

Figure 30. Forest Map

4.13. Urban and rural settlements

Urban land occupies 0.4% of the total area of Mongolia in 2010 or 6200 km^2. The total area is relatively small but at Ulaanbaatar the area occupied by buildings, industries and roads is growing rapidly, due to the influx of people and the economical development of the capital city. The growth of the urban areas in the aimags is limited due to the slow economical development in the rural areas.

In addition, soil and plant cover of rural land and urban land erodes from the construction of new buildings and industries. Urban settlements are also affected by air pollution and contain more concentrated sources of pollution than other classifications of land, and this area of land is degrading ecologically. Because of dense populations, the land debate cannot be solved easily in urban settlements.

4.14. Mining

Another feature that is having a significant impact on the landscape is mining even though mining only occupies 0.06% of the total land area of Mongolia (about 1000 km^2). It plays a main role in the economic development of the country. Through the activities of large mining industries, the appearance of the local landscapes (e.g. river beds, excavated soils and waters, etc.) has changed enormously. In recent years the country has struggled to manage the sustainable use of natural resources and to reclaim depleted mining sites.

A total of 21.7% of the land of Mongolia is occupied by mining exploitation licenses. This percentage indicates the large mining potential of the country.

In the frame of the Law on ”Prohibition of Mineral Prospecting Exploration in Runoff forming Areas and Forest Areas” the Water Authority determined that out of a total of 26,624.1 km^2 area of exploration, 769.6 km^2 of exploration area is included in runoff forming and water protection zones. The runoff forming area was determined by IMH.

The locations of exploration and exploitation area, runoff forming area and water protection zones are shown in Figure 31, Figure 32 and Figure 33. By the land report of 2010, 16061 ha land or 160.6 km^2 was destroyed because of mining.

Source: WA

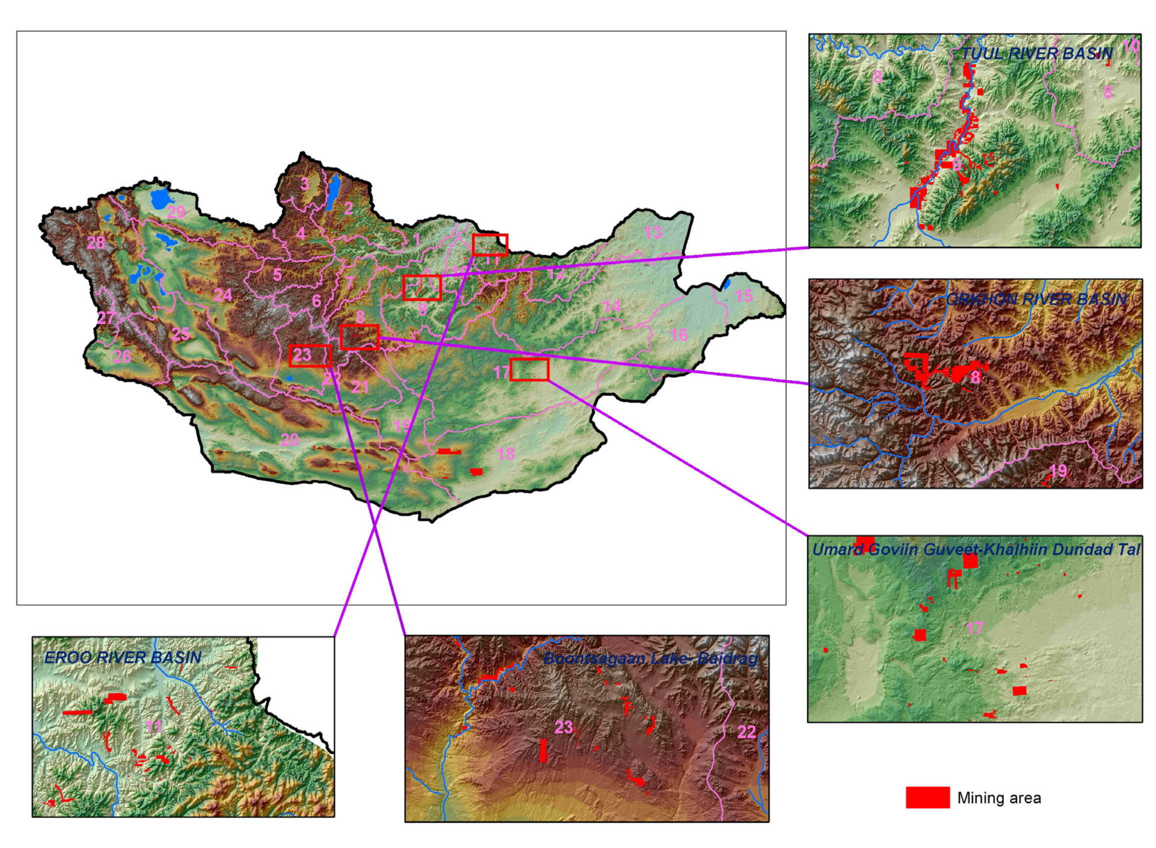

Figure 31. Location of mines, 2008

Source: WA

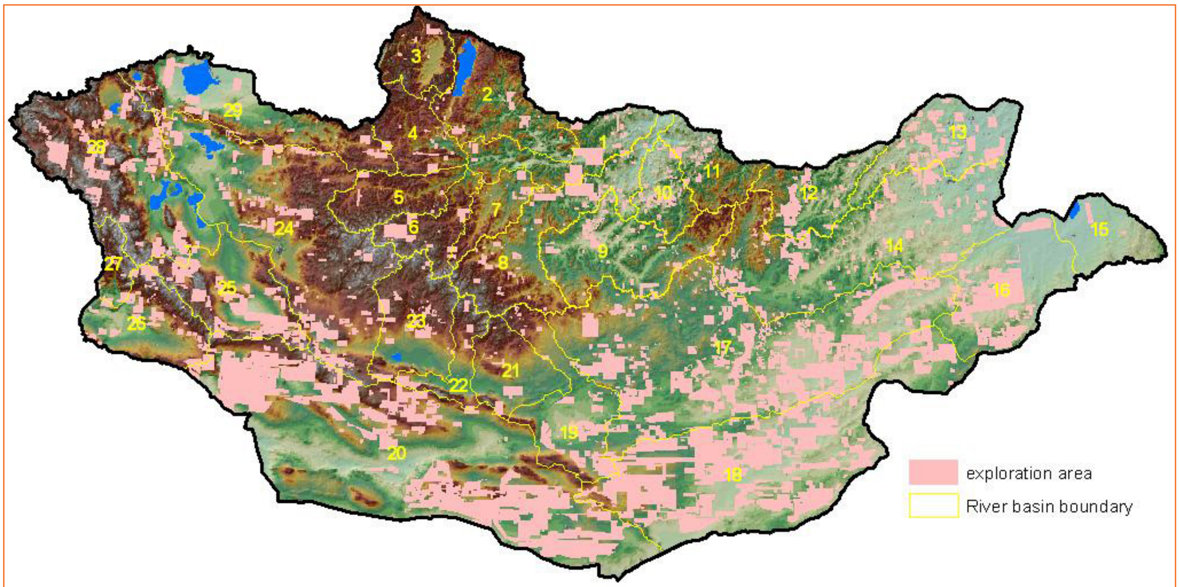

Figure 32. Location of exploration areas, 2008

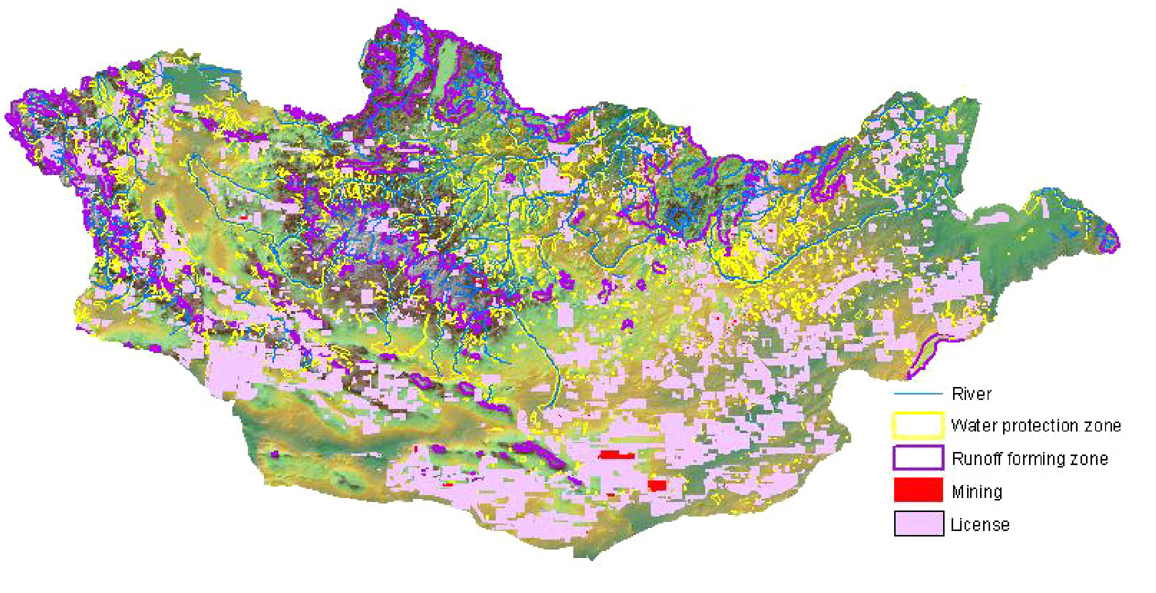

Figure 33. License and mining area in Runoff forming and protection zones

4.15. Current condition of land ownership

In relation to changes in the society it is necessary to secure the legislation environment of land relations in Mongolia, so for this purpose a package law was approved about the land of Mongolia. In the frame of these laws, the main condition is established to regulate relations between the citizens, entities, enterprises and state on land ownership, utilization or land protection. At the same time the government policy on land issues is implemented, reflecting comprehensive organisational measures as to protect land reserves, its pattern and quality; to keep its nature; to provide map making its registration and providing research study; define land tariff, land fee and restoration of degraded lands.

In the Law on Land of Mongolia it is specified that the terminology of land relations should be used and understood and follows:

- "To own land" means to be in legitimate control of land with the right to dispose of this land;
- "To possess land" means to be in legitimate control of land in accordance with purpose of its use and terms and conditions specified in respective contracts;
- "To use land" means to undertake a legitimate and concrete activity to make use of some of the land's characteristics in accordance with contracts made with owners and possessors of land;

It is over 10 years as citizens, entities or enterprises began to own and use land with legal rights in Mongolia. In the end of each year data and information is submitted of the land owners, users and holders and of information about lands that are under land relations by aimags and the whole country.

As of 2010, 4,964,416 ha land was possessed, owned and used. Some 27,375 ha is owned, 4,807,025 ha is possessed and 130,015 ha is used.

There are some 573,544 land owners, possessors and users in our country. There are 245,749 land owners, some 326,054 people are possessors and others are users. There are some 1180 entities and organizations and some 561 land users and land use entities.

Mongolian citizens started to own land and some 21838 people owned a piece of land for their family demand without any fee in 2003.

It increased as follows: 43224 in 2004, 69950 in 2005, 17080 in 2006, 21707 in 2007, 28944 in 2008, 19001 in 2009 and 27375 in 2010.

At the end of the year 2010 nationwide, some 245,345 people owned land for their family demand.

As measurements to protect the land are included: restoration of destroyed dogged land, destruction of rodents and forest cleaning. Also by aimag and soum center an annual plan of land organizational structure is implemented to protect the land.

As of 2010 in the whole territory, several protection measurements were organized on 4.6 mln ha. This included planting and restoring trees and bushes; measurements to clean household waste; strip cultivation, enrichment by mineral fertilizer, trench and hole smoothing.

5. Major issues in relation to land use

This chapter is intended to give a preliminary overview of the pressures that affect the land use. The description will be input for the determination of the final list of river basin water issues.

From Davaadorj (2009):

From studies on used agricultural area and water resources of Mongolia conclusion and suggestions are as following;

1. the land area of Mongolia is big enough, but to animal numbers and species it is not enough;
2. no regulations on common and free pasture grazing create limitations for initiatives for protection and maintaining the pasture taking away the duties and care of herders to pasture;
3. the number of sheep and goats is the main reason of pasture overgrazing, while their number is in excess for domestic needs and exportation does not take place;
4. another affecting factor to pasture degradation is the abandonment of traditional methods for using pasture with four seasons schedule; particularly in the beginning of the summer, when grass regrows and in the autumn when plant seeds mature grazing in one place by excessive numbers of goats leads to the disappearance of flowering plants;
5. also, keeping too many horses in one place in the winter near pasture of sheep and goats and year sequence haymaking are the reason for non refreshing the pasture and grass types decrease;
6. pasture water supply measures do not cover the demand and requirement and are not planned in detail, while it is difficult to estimate how many water points a soum possesses, including the damaged one's; in some cases too many wells are drilled in one place, causing pasture degradation nearby, while in other places big pasture area cannot be exploited because of water shortages;
7. Mongolia possess 1.7 million ha farm friendly area, but just uses 474.8 thousand ha area or 27.4 per cent of the available total.

The insufficient use of the planting area is caused by the weak financing capability of farmers and the high risk in non irrigated farming in dry agro ecology.

Studies in the middle 1980s found 395 thousand ha area good for irrigation, however, since than many rivers and streams dried up and the water resources of lakes have decreased. Studies carried out between 2004 to 2008 found 190 thousand ha convenient for irrigation area (excluding Kherlen river basin), however, in 2008 only 25.4 thousand ha was used, meaning that only 13 per cent is used of the real possibilities.

Studies carried out in 1985 concluded that the basin area of Kherlen River is capable to irrigate 92.1 thousand ha in terms of water and soil properties. Since than the facts have not been clarified and the Ministry Food, Agricultural and Light Industry is intending to carry out study in 2010.

It may be believed that under current circumstances of water and soil at least 200-250 thousand ha area may be irrigated within the country.

From Baasandorj (2008):

Planning and implementation of practical actions on rehabilitation and combating desertification depends on the current state of the environment as well as on deep knowledge about factors affecting this environment. Conservation and rehabilitation activities should consider the following points:

- Land use planning: directed to regionalize territory according to the specifics of production and industry sector ensuring decentralized development directed to diverse income generation;
- Methods to prevent desertification: rational use of pasture, conservation and sustainable use of forest and other biological resources, maintain water supply, establish early warning system for prevent pest insect distribution, forest and wild fire and other disasters;
- Establish network of specially protected area: to conserve biological diversity and protect species threatened by land degradation and desertification and promote sustainable management in pilot area it is recommended to establish SPAs in some hot spot area.
- Establish combating desertification management system: the system should be response for conservation and rational use f natural resources, establish suitable legal environment, train and educate rural decision makers as well as community in environmental protection issues, operating early warning system and information sharing;
- Re-vegetation: train rural to plant naturally adapted tree species to prevent land degradation as well as to plant cash trees to promote alternative income generation supporting poverty alleviation strategy. Moreover, gardening in urban area, establishing windbreaks for fixing sand are proposed.
- Reduce desert encroachment: to prevent sand movement and related disaster apply appropriate methodologies in agriculture system.
- Water harvesting: regulate water flow, decrease evaporation, water harvesting through establishment of micro and macro catchments.

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Annex 1. Pasture land of Mongolia

Text from: Land use in Mongolia prepared by Ya. Baasandorj, Geo-ecology institute during Inception Phase of the project

Agricultural land of Mongolian is classified as pastureland, hay land and cultivated area. Natural pasture land divided into 200 types of pasture and 900 of 2800 species vascular plants that listed in Mongolia are used for livestock forage. Nomadic pastoralism was part of Mongolian economy since ancient time. Vegetation cover started to be used to pasture since 8-5th century BC and researchers have noted about singnificant changes of pastureland in last 2 centuries.

Total pasture capacity is 73.8 million ton/year which is equal to 60-70 million heads. Pastureland in the land integrated fund is determined as “agricultural land that has natural or cultivated vegetation and where wild and domestic animals can graze”.

Mongolia has large topographical differences and climate is harsh continental thus pasture vegetation changes significantly through time and space. Mongolia locates between Siberian taiga, Central Asian steppe and Gobi desert thus pasture vegetation decrease as go south.

Low precipitation during winter enables good preservation of pasture during winter. Appropriateness of long term regulations of nomadic herders to such characteristic

About 75.1% of the total Mongolian territory belongs to pastureland and Institute of Land policy implemented mapping and research of pastureland with 1:100,000 and 1:200,000 scale between 1975-1995. There are 232 types of pasture in Mongolia that belong to 9 subdivisions.

Major ecological and geographical types of Mongolian pasture

Major pasture subdivisions	Area of the subdivision to total pastureland	Number of pasture types	Average biomass 100kg/ha
1. High mountain	5.3	15	2.4
2. Mountain meadow steppe	3.3	24	4.0
3. Mountain steppe	21.3	28	2.8
4. Mountain meadow	2.5	21	8.4
5. Steppe of flat areas	22.8	38	3.5
6. Riparian	2.1	32	5.7
7. Meadow of depressions	3.8	29	6.7
8. Desert steppe	19.5	24	1.6
9. Desert	19.4	21	0.9
Total	100.0	232	-

Riparian pasture has most diverse types and most area of pasture belongs to mountain steppe and steppe of flat areas. Average biomass of the Mongolian pasture was 380 kg/ha during summer time of 1975-1995, 220 kg/ha in spring and average were 290kg/ha, which is 19.5-24.2% low compare with data from 1960’s. Large areas of pastureland are not very suitable for pasture and have overgrazing.

There are 5735.5 thousand ha high mountain pasture, 20375.9 thousand ha forest steppe pasture, 35652.0 thousand ha steppe pasture, 82139.6 thousand ha desert pasture.

a/ **High mountain pasture** found in the summit of the Khangai, Hovsgol, Mongol Altai, Gobi-Altai ranges and due to low temperature and precipitation, one could find ...-mesophytic and ... vegetation. One could find desert and dry steppe vegetation in summit of the Khangai, Mongol Altai and Gobi Altai mountains.

Average percent cover is 70-80%, average biomass is 450-550 kg/ha, there are 20-25 species per 100 m^2.

b/ Forest steppe pasture found in mountains of Khangai, Hentii, Mongol-Altai, in the zones of Khangai and in north western and central part of Mongolia. Dominant vegetation is grass and rich with different species. Lowest altitude of this pasture can be found in 950-1300 meter in Hentii, in 1300-1500 meter in Khangai and in 1800-2000 meter in Mongol Altai mountains. Average percent cover is 65-70%, average biomass is 750-830kg/ha and there are 30-35 species/100m2.

c/ Steppe pasture can be found in eastern side of Mongolia, in Central Khalkha plateau and reach Great Lakes depressions. This group includes many different types of pasture. Dominant vegetation type is *Cleistogenes-Stipa, Stipa-Leymus, Stipa-Thymus-Cleistogenes, Stipa, Allium-Stipa. Caragana-Stipa*. Average percent cover is 50-55%, average biomass is 400-450kg/ha and there are 20-25 species/100 m2.

d/ Desert steppe pasture found in the southern part of Mongolia and reach Lake Uvs in the west. Dominant plants are small needlegrass and many shrubs compose this pasture. Average percent cover is 30-35%, average biomass is 150-190 kg/ha and there are 15-20 species per 100 m2.

e/ Desert pasture found in southern side of the Mongol-Altai, Gobi-Altai mountains and mainly composed of shrubs and semi-shrubs and species of *Salsola*. There are sandy desert pasture and rocky desert pasture. Average percent cover is 15-20%, species composition is 10-15 species /ha and there are 110-250kg/ha biomass.

Modern ecological state of the pasture, conservation and exploitation need to determined based in soil erosion and pasture grazed conditions.

Pasture biomass change

According to our research, livestock grazing cause pasture degradation and its biomass change. Thus, pasture biomass change in past 40 years been researched by natural zones and some examples of this research at some province and soum compared in below table.

Pasture biomass change

Natural zone	Province, soum name	Pasture type	1961 – 1962		1981 - 1982		2001-2005	
			Biomass, Ha/ce	%	Biomass, Ha/ce	%	Biomass, Ha/ce	%
High mountain	Khankh soum of Khuvsgul province	Kobresia-forbs	9.7	100	7.3	75.2	5.5	56.7
		Fescue-stablegrass-forbs	12.5	100	10.9	87.2	8.1	64.8
Forest steppe	Bayangol soum of Selenge province, Kharkhorin, Uyanga soum of Uvurkhangai province	Forbs-stablegrass	16.0	100	10.0	62.5	6.5	40.6
		Fescue-forbs	7.0	100	5.8	82.8	5.3	75.7
		Needlegrass-stablegrass	10.5	100	8.5	80.7	6.3	60.0
Steppe	Erdenesant soum of Tuv province, Gurvanbulag soum of Bulgan province, Delgerhaan soum of Khentii province, Tumentsogt soum of Sukhbaatar province	Needlegrass-bridlegrass	6.4	100	4.2	65.6	3.3	51.5
		Peashrubs-stablegrass	5.3	100	3.2	60.4	2.5	47.2
		Ders-sedge	16.0	100	12.0	75.0	7.5	46.8

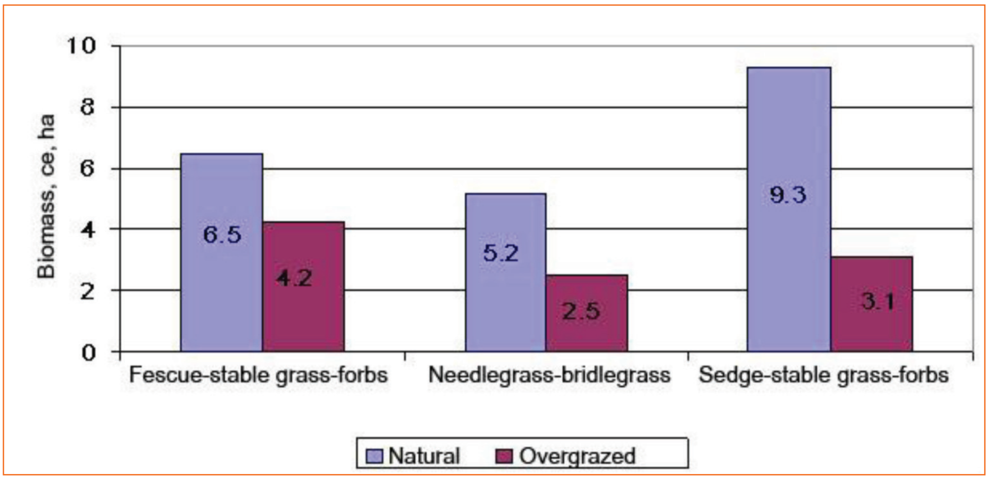
Natural zone	Province, soum name	Pasture type	1961 – 1962		1981 - 1982		2001-2005	
			Biomass, Ha/ce	%	Biomass, Ha/ce	%	Biomass, Ha/ce	%
Desert steppe	Bayandelger soum of Sukhbaatar province, Sumber, Shiveegovi soum of Govisumber province	Feathergrass-onion	5.0	100	2.8	56.0	2.5	50.0
		Feathergrass-peashrubs	4.0	100	3.3	82.5	3.4	85.0
		Soltwart	4.5	100	3.5	77.7	3.4	75.5
Desert	Bugat soum of Govi-Altai province, Tonkhil, sharga, Huh morit soum of	Feathergrass-anabasis	4,9	100	3,7	75,5	3,2	65,3
		Anabasis	3,5	100	3,2	91,4	2,9	82,8

Although, pasture biomass of past 40 years has decreased by more than 50 percent, biomass decrease of fescue-forbs, feathergrass-peashrubs, saltwort, anabasis type of pasture has comparatively sustained.

Three types of natural and overgrazed pasture in Kharhorin and Uyanga soums of Uvurkhangai province and Khotont soum of Arkhangai province are the example of forest steppe pasture and have sampled for pasture biomass and change of species composition in five repetitions.

Biomass of one hectare and change of species composition in natural and overgrazed pasture of fescue-stable grass-forbs, needlegrass-bridlegrass, sedge- stable grass-forbs types of pasture have compared in following figure.

Biomass change per hectare of natural and overgrazed pasture



The figure shows that pasture biomass of fescue-stable grass-forbs and needlegrass-bridlegrass has decreased 1.5-2 times, and sedge-stable grass-forbs pasture decreased 3 times comparatively from natural to overgrazed pasture.

Natural and overgrazed pastures in Bayandelger soum of Sukhbaatar province, Saihandulaansoum of Dornogovi province and Sumber and Shiveegovi soums of Govisumber province are the example of steppe and desert steppe pasture and have sampled for decrease pasture biomass and change of species composition in about 150 repetitions research result shows that almost 40 percent of all those pastures is overgrazed.

The table below indicates that because of overgrazing, biomass of needlegrass-bridlegrass-peashrubs, needlegrass-forbs pasture of arid steppe decreased 2 times, biomass of feathergrass-peashrubs and feathergrass-bridlegrass pasture in desert steppe decreased by 16-17 percent and saltwort by 35 percent and ders-sedge by 2 times, respectively.

Pasture biomass change

Ecological condition	Pasture type	Repetition number	Natural	Overgrazed
			Average biomass per hectare, ce	Average biomass per hectare, ce
Arid steppe	Needlegrass-bridlegrass-peashrubs	5	6.1	3.1
	Needlegrass-forbs	3	5.3	2.3
Desert steppe	feathergrass-peashrubs	5	2.9	2.4
	feathergrass-bridlegrass	3	2.3	1.9
Low	Saltwart	3	3.2	2.1
	Ders-sedge	5	8.1	4.2

Research by O.Chognii and N.Narantuya shows that increased livestock grazing affects plant species reduction and height of forage is no more than 10 cm and biomass is decreasing 2-5 times than in natural pasture.

According to our research, biomass of overgrazed pasture decreased 1.5-2 times in relation to natural pasture and plant species change; certain arid plants are increasing by 62.9 percent and prevalent of total biomass (60-70%) fertile is not qualified.

Soil erosion of pastureland.

Necromass or dead mass of the pastureland locally named as blue residue were used intensively and removed, which changed water and heat regime of the soil, which in turn will affect the vegetation cover. This situation makes soil more dry and sand storms occurred more often.

Places with dead necromass are very rare, today. Some parts of the forest steppe, some parts of the Eastern steppe, Shiliin Bogd in Sukhbaatar aimag, and Malakhiin Tal can be included in such areas.

Not Degraded Pasture in Eastern Steppe

Dead or necromass in Malakhiin Tal

During two season of year −winter and spring soil being open becomes more and soil blows with the wind and land surface become rocky. Although this rocky surface preserves soil cover, it affects badly to the physical structure of the soil. Especially, water adsorption becomes less and precipitation flows in little slopes. This can be a reason of vegetation cover lack in past few years.

Булган аймгийн 8 сумын бэлчээрийн газрын гадаргын том, жижиг чулуутай талбайг тодорхойлж дараахи хүснэгтэд үзүүлэв.

Stony Places in Pastureland

№	Soum	Total area, thou.ha	No stone		With stone			
					Big stone		Small stone	
			thou.ha	percent	thou.ha	percent	thou.ha	percent
1	Bayannuur	99.0	70.4	71.1	14.9	15.0	13.7	13.8
2	Buregkhangai	334.5	27.9	8.3	256.9	76.8	49.7	14.8
3	Gurwanbulag	265.2	53.3	20.0	85.5	32.2	126.4	47.6
4	Dashinchilen	240.3	151.4	63.0	54.2	22.5	34.7	14.4
5	Mogod	250.3	24.7	9.8	29.8	11.9	195.8	78.2
6	Rashaant	101.2	80.2	79.2	13.9	13.7	7.1	7.0
7	Saikhan	265.1	51.4	19.4	196.4	74.1	17.3	6.5
8	Khishig-Undur	225.3	25.9	11.5	174.5	77.4	24.9	11.0
Total		1780.9	485.2	27.2	826.1	46.4	469.6	26.4

The table shows that 27.2 percent of the study area was not covered by the stones and rocks, 46.4 percent were covered by the rocks and 26.4 percent were covered by the small stones.

Surface with Small Stones.

The table below shows the soil erosion of the study area. Soil erosion is more intensive in dry steppe and desert steppe areas.

Pastureland Soil Erosion in 8 Soums of Bulgan aimag, thou.ha

°	Soum	Total area, thou.ha	Common pasture		Soil erosion		Of which					
							Slight		Moderate		Severe	
			thou. ha	Per cent	thou. ha	Per cent	thou.ha	Per cent	thou. ha	Per cent	thou.ha	Per cent
1	Bayannuur	96.0	11.5	12.0	84.5	88.0	2.7	3.2	29.3	34.6	52.5	62.2
2	Buregkhangai	324.0	0.4	0.2	323.5	99.8	172.8	53.4	94.0	29.0	57.2	17.6
3	Gurwanbulag	266.3	-	-	266.3	100.0	27.7	10.4	149.7	56.2	88.9	33.4
4	Dashinchilen	231.9	-	-	231.9	100.0	13.2	5.7	102.0	44.0	116.6	50.3
5	Mogod	247.8	35.	14.2	212.6	85.8	161.7	76.1	26.9	12.6	24.0	11.3
6	Rashaant	101.2	0.8	-	100.4	99.2	7.8	7.8	25.8	25.7	66.8	66.5
7	Saikhan	257.8	-	-	257.8	100.0	188.4	73.1	39.1	15.2	30.2	11.7
8	Khishig-Undur	213.2	-	-	213.2	100.0	85.4	40.0	93.2	43.7	34.6	16.3
Total		1738.1	47.9	2.7	1690.2	97.3	659.7	39.0	560.1	33.1	470.8	27.9

We offer the most eroded areas by the fragmented map. Soil erosion of the pastureland has been evaluated by the change of the fertility alteration. Table above offer that soil erosion level of the Dashinchilen, Gurvanbulag, and Rashaant soums were higher compare to the other soums. 55.6-66.8 percent of the soil erosion of these areas was moderate or heavy erosion and this indicates that territory of the soums can be source of the desertification and land degradation.

Results of this research show that 97.3% observed territory of Bulgan aimag is eroded. Of this eroded territory 33.1% moderate and 27.9% has heavy erosion and erosion process is more seriously existing in Bayandelger, Where 47.8% of eroded land have moderate erosion rate and 19.4% have heavy erosion.

Soil bulk density and its change

Soil bulk density defined by soil liquid, solid and gase phases and it relates from soil texture, organic matter content, structure and moisture. When the soil pores get smaller, the microorganism activities getting slowly and causes plant root death. Also if the soil sompacts, its water absorbtion and penetration are decrease and damages soil water erosion.

The figure shows 5.4% increase of bulk density of the surface layer. Soil bulk density of the control areas was 1.12 g/cm^3 in the 3-7 cm, and 1.14 g/cm^3 in the 12-16 cm, while in the overgrazed areas, 1.18 g/cm^3 and 1.13 g/cm^3 in respectively.

Also bulk density of steppe brown soil of natural pasture has increased by 1.12±0.04 g/cm^3, 1.15±0.05 g/cm^3 in moderately grazed and 1.20±0.04 g/cm^3 in overgrazed pasture.

Soil agregation, its change

Combination of the pasture land soil particles can be presented by the soil aggregate size. Percent of soil particles larger than 1 mm represent the tolerance of the soil to wind and water erosion and stability level

Soil aggregate size of the control and overgrazed pasture is determined at about 20 profiles in 4-5 repetition soil samples by sieving 0.1 mm, 0.5 mm and 1.0 mm soil sieves.

The soil aggregate of steppe brown soil is determined by the some method as had in mountain brown soil.

Aggregate of steppe brown soil, percentage

Soil depth, cm	Aggregate, mm	Natural	Overgrazing	
			Moderate	Strong
0-10	>1.0	53.5±2.09	38.9±2.92	22.0±3.97
	1.0-0.5	30.1±2.30	32.8±3.55	47.2±4.27
	0.5-0.1	9.6±2.11	12.2±2.06	22.2±1.35
	<0.1	7.5±3.49	7.8±2.41	8.5±3.94
10-20	>1.0	55.4±5.06	53.2±3.32	51.3±4.17
	1.0-0.5	31.9±3.96	32.3±3.56	29.9±1.63
	0.5-0.1	9.3±1.55	10.5±2.19	13.2±3.07
	<0.1	3.3±1.81	4.2±1.54	5.4±1.12

The table shows that the particle sizes of more than 1.0 mm is 53.5±2.09 percent in 0-10 cm depth and 38.9±2.92 percent in moderate overgrazing and 22.0±3.97 percent in strong overgrazing.

The particle sizes of 1.0 mm -0.5 mm is 9.6±2.11 percent in natural pasture and 12.2±2.06 percent in moderate overgrazing and 22.2±1.35 percent in strong overgrazing.

Soil aggregate in 0-20 cm depth is not indicated for the pasture degradation.

Soil degradation causes the wind erosion and it results air dust and dust storms.

Annex 2 Soils of Mongolia

Text from: Dorjgotov.D, Batkhishig.O., New version of Mongolian soil classification system.

The Mongolia is country with very specific nature conditions and ecological situations. There is intercontinental location, geological history of territory , high position and specifics of mountain, plain, intermountain depression features. Other hand, marked substantial contrast of nature factors in different parts of country, that's defined specifics of soils and soils cover of country.

On the territory of Mongolia, from north to southwards changed following longitudinal-zonal schema of soil cover:

1. mountain taiga zone with cryomorphic-taiga and demo taiga soils,
2. mountain forest-steppe zone with chemozem, dark kastanozem, forest dark colored, and demo taiga soils,
3. dry steppe zone with kastanozem soils,
4. zone -brown semidesert soils,
5. zone -gray-brown desert soils,
6. zone -extra-arid desert "borzon" soils.

The wide distribution of taiga and forest-steppe soils in Nortem Mongolia not possible explain by just vertical zone, there is also influence of horizontal zone of territory.

The horizontal zone more clear represented in the central, comparatively plain part of Mongolia, where zone of kastanozem soils divided into three sub zones (dark kastanozem, kastanozem, light kastanozem), and brown semidesert soil zones divided into two sub zones (brown desert-steppe, brown stepped-desert).

By the climatic conditions, every soil-nature zone of Mongolia together with territories completely differed similar zones of western Eurasian analogs. The facial specifics of Mongolian climate with central continental locations, influences of stabile anticyclone regimes defmed unique soils of Mongolia, even in local levels to form a specific type of soils.

The Mongolian soils characterized by strong freeze of upper part of soils in winter time, deep freezing down to 3-4.5m, long period with seasonal permafrost's (6-9 months of year). The coincidence of warm months with most rainy seasons of year, make a this period biological active. In this period's comparatively rise an amount of carbon dioxide in the soils, this influenced shift of air carbonates to the soluble forms consequently more migration form, and in same times in the soil profiles dominated moisture penetration regime. All of these situations provided geochemical migration of carbonates in steppe soils of Mongolia, so why upper part of soils usually leached by carbonates, some cases occurred without carbonate variant. Such very clear migration of carbonate usually not marked in the steppe soils of other regions.

Arid soils of Mongolia characterized by; presence of "meal like" form of carbonates, very active deflation erosion process, absence of soluble salts, gypsum and solonetsic features.

The distinctness or peculiarities of Mongolian soils become more clear in cryogenic conditions and in extra arid conditions, both. In these situations formed specific cryogenic-taiga soil, and extra arid desert "borzon" soil. Within these 'extra contrast territories formed specific featured soils, which enabled to distinguish as an independent facial (provincial) subtype within the type of similar landscape of other regions of Eurasian continent.

The comparative analyze of available materials of soil cover of Mongolia and neighbouring regions of continent's, enabled that a necessity of distinguish Mongolia with neighboring northern territories of Russia (Tuva, Zabaikal) in to the independent extra continental Central -Asian soil-bioclimatical facia.

There are general specific peculiarities of this facia:

1. slow process of chemical weathering and clay formation,
2. specific process of geochemical migration element,
3. slow biological cycling of elements and comparatively easy change of elements from biological to the geological cycle of migration,
4. short biological active period, not only reasoned by deficit of moisture, also long lasting minus temperatures in the soil,
5. sharp differences and peculiarities of seasonal process of soil forming even in the warm period of year, reasoned by contrast character of moisture, very clear monsoon character of precipitation,
6. basically soil forming process in minus temperatures or low plus temperatures,
7. short soil profile and humus layer.

The specific of soils of Mongolia connected not only peculiarities of present soil forming process, also wide distribution of some relictic feature inherited by former period of historical development in this old continent. For the such properties included:

1. differences of soil forming sediment in plain area, by geological age, stone and texture content,
2. presence of strongly carbonated layer and absence in the basically sediments soluble salts and gypsum,
3. paleocryogenic wedge or crack in the plain soils, which reasoned to form a hidden cryo-lithogenic mottles in soils profile,
4. residual paleocryomorphic and paleohydromorphic features in the steppe soils,
5. residual solonetcic properties.

All zonal soils of Mongolia divided in two groups:

1. soil of mountain,
2. soil of plain area and intermountain depression.

The slope soils differed from plain analogs not only by forming conditions, also character ofuse and genetical peculiarities.

For the forming of mountain soils essential influence is slope process. From dates of stationary investigations in Northern Mongolia, surface runoff in the slopes (chernozem soil) 18° degree is 83-100 m3/hec, in the slopes 5° (dark kastanozem soil) 45 m3/hec in year; annual amount of surface wash off is 418-681 kg/hec and 330 kg/hec comparatively. Some wet year's quantity of surface wash off reach to 1900- 2500 kg/hec. Beside mechanical denudation, on the mountain slopes occur intensive geochemical outwash of substrata on surface and inter soil flux. The mountain soil characterized by:

1. freshness (young) all time, this is connected with intensive slope process, which lead to non-stop involvement of the soil forming process new fresh materials;
2. shaUow profile, weak differentiation of soil profile;
3. non -sorted, highly gravelly soil material,

4. well drained, leached, often without carbonate, and very unclear carbonate horizon even steppe soils,
5. comparatively high content of humus with domination ofundecayed organic residues,
6. domination in the profiles clear chromatic (reddish- brown, ochre) hue.

Introduced new classification of soils developed, clarified by authors on base of own field investigation and other published materials.

Systematic list (classification) of Mongolian soils

The Mongolia has big soil resources suitable for agriculture and forestry purposes. The analyze of present condition of land resources show, that on the agriculture, pasture, and forest ecosystems of Mongolia occurred intensive degradation, erosion process result of anthropogenic pressure, this is leaded lose of soil fertility and worsening of properties. Scale of this process is very big especially on the non-irrigated agriculture land areas.

I. MOUNTAIN SOILS

1. Mountain tundra soils

1.1 Type: Mountain tundra ochro soil ("podbur)
  Subtype:
    1. Typical
    2. Raw-humus
    3. Podzolic
    4. Gleyed
1.2 Type: Mountain tundra peaty-gleye soil
1.3 Type: Mountain tundra cryoturabated (destructed) soil

2. Mountain meadow, mountain meadow-steppe soils

2.1 Type: Mountain meadow brunizem (alpine) soil
2.2 Type: Mountain meadow dark colored raw- humus soil
  Subtype:
    1. Typical (dark colored)
    2. Ochric
    3. Chemozem-like
    4. Gleyed
2.3 Type: Mountain meadow peaty raw-humus soil
2.4 Type: Mountain meadow-steppe nlull-humus soil
  Subtype:
    1. Typical
    2. Meal carbonated (kastanozem-like)
    3. Crypto-gleyed

3. Mountain forest soils

3.1 Type: Mountain taiga cryomorphic ochro soil (podbur)
  Subtype:
    1. Typical
    2. Surfacely ferrimorphic
    3. Podzolic
    4. Gleyed
3.2 Type: Mountain taiga cryomorphic peat-muck hunlus soil
  Subtype:
    1. Typical

2. Gleyed

3.3 Type: Mountain taiga podzolic soil

3.4 Type: Mountain derno-taiga (ferrimorfic) soil

Subtype:

1. Typical
2. Raw humus
3. Podzolized
4. Crypto-gleyed

3.5 Type: Mountain forest, dark colored derno soil

Subtype:

1. Typical
2. Meal carbonated
3. Crypto-gleyed
4. Gleyed
5. Raw humus
6. Buried layers

3.6 Type: Forest slightly podzolic sandy soil

4. Mountain steppe soils

4.1 Type:High mountain steppe raw humus soil (pillow like steppe)

Subtype:

1. Typical
2. Ochric
3. Pillow like

4.2 Type: Mountain chernozem

Subtype:

1. Non carbonated
2. Meal carbonated
3. Crypto-gleyed

4.3 Type: Mountain kastanozem

Subtype:

1. Non carbonated dark kastanozem
2. Meal carbonated dark kastanozem
3. Meal carbonated kastanozem
4. Meal carbonated light kastanozem
5. Crypto-gleyed

5. Mountain desert-steppe and desert soils

5.1 Type: Mountain semi-desert brown soil

5.2 Type: Mountain desert gray brown soil

II. PLAIN AND VALLEY SOILS

6. Steppe soils

6.1 Type: Chernozem

Subtype:

1. High humic
2. Low humic
3. Crypto-gleyed
4. Anthropogenic

6.2 Type: Kastanozem

Subtype:

1. Dark kastanozem
2. Kastanozem

3. Light kastanozem
4. Crypto-gleyed
5. Anthropogenic

7. Semidesert and desert soils

7.1 Type: Semidesert brown soil
Subtype:
1. Brown
2. Light brown
3. Crypto-gleyed
4. Anthropogenic

7.2 Type: Desert gray-brown soil
Subtype:
1. Grey brown
2. Crypto-gl.eyed

7.3 Type: Extra-arid desert "Borzon " soil
7.4 Type: Takyr
Subtype:
1 I. Takyr
2. Takyr like

8. Hydromorphic soils

8.1 Type: Meadow dark humic gleye soil
Subtype:
1. Crypto-gleyed
2. Gleyed

8.2 Type: Meadow-boggy raw humic gleye soil
Subtype:
1. Raw-humic gleyed
2. Gleyed

8.3 Type: Boggy peaty gleye soil

9. Halomorphic soils

9.1 Type: Solonchak automorphic
9.2 Type: Solonchak hydromorphic
Subtype:
1. Gleyed
2.Crypto-gleyed

9.3 Type: Solonetz automorphic
9.4 Type: Solonetz hydromorphic

10. Floodplain soils

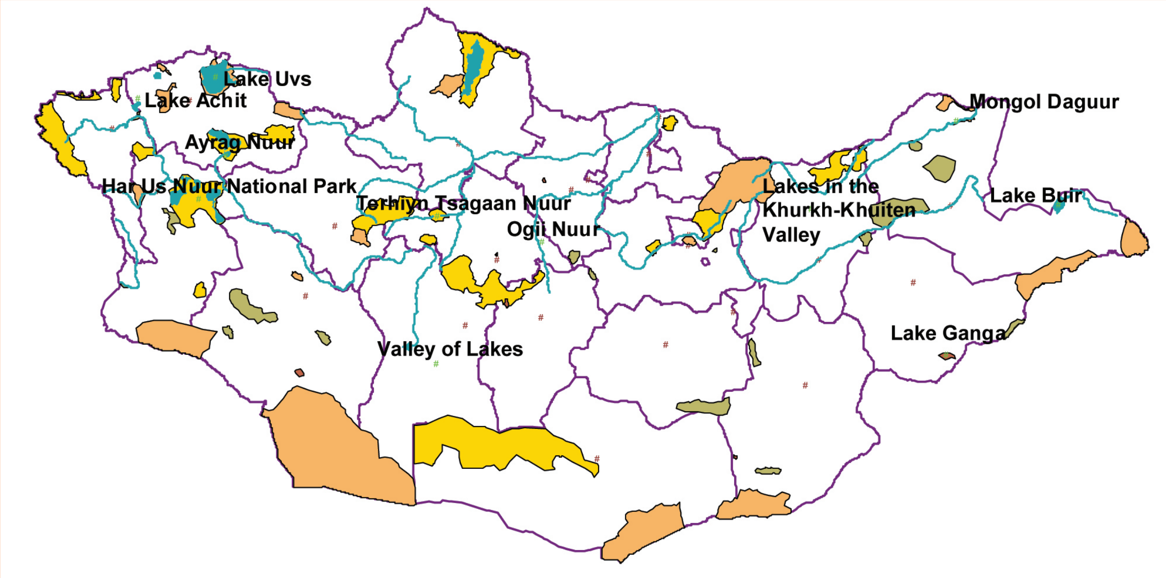
10.1 Type: Alluvial boggy gleyed soil
Subtype:
1. Alluvial meadow boggy raw humus gleyed
2. Alluvial meadow boggy demo gleyed
3. Alluvial boggy clayed, gleyed

10.2 Type: Alluvial meadow gleyed soil
Subtype:
1. Alluvial meadow derno- gleyed
2. Alluvial meadow dark colored crypto-gleyed

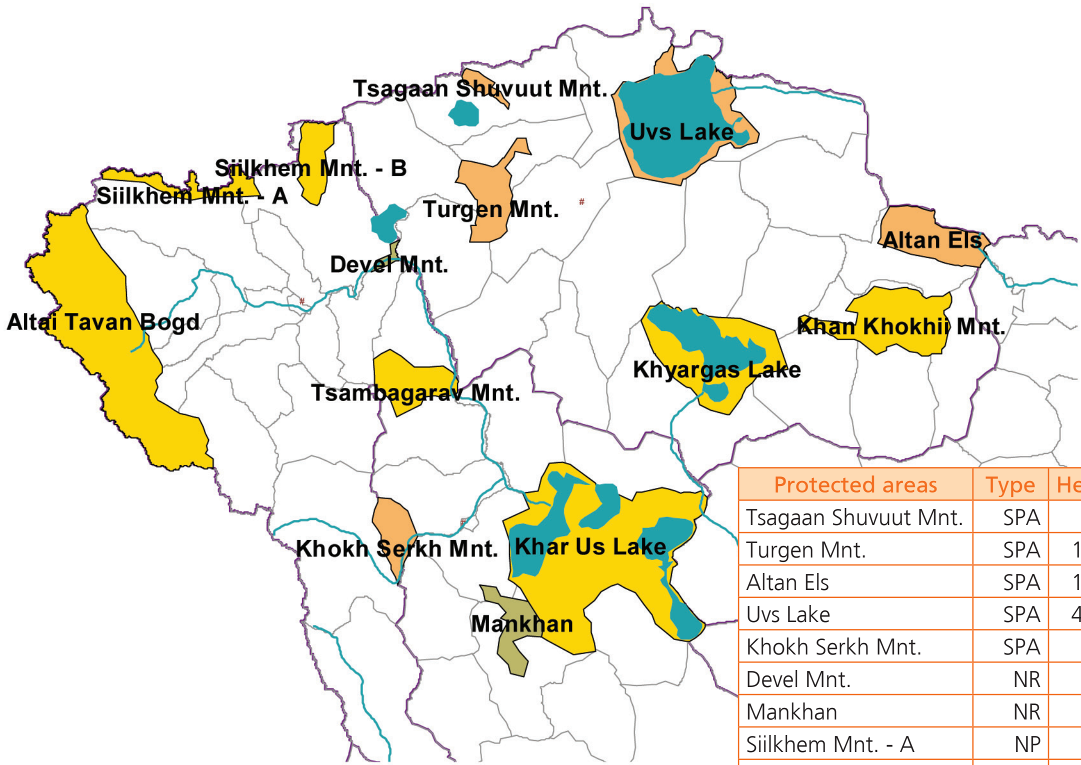
10.3 Type: Alluvial derno soil

Annex 3. Protected areas and Ramsar sites

Map of Protected areas and Ramsar sites

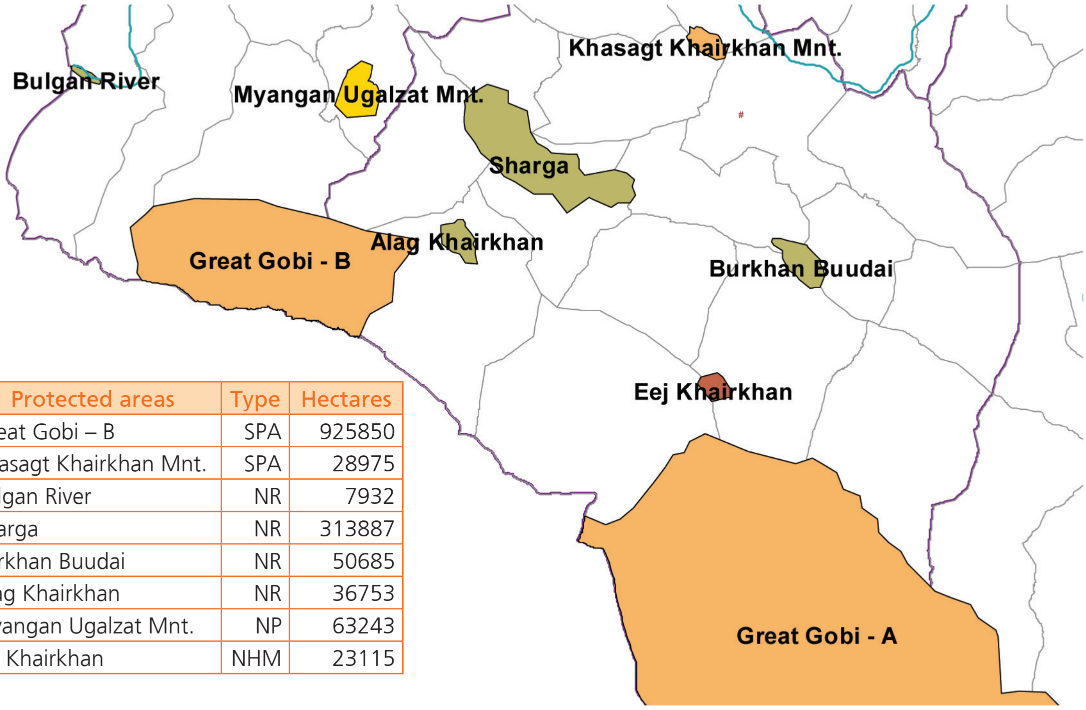


North West



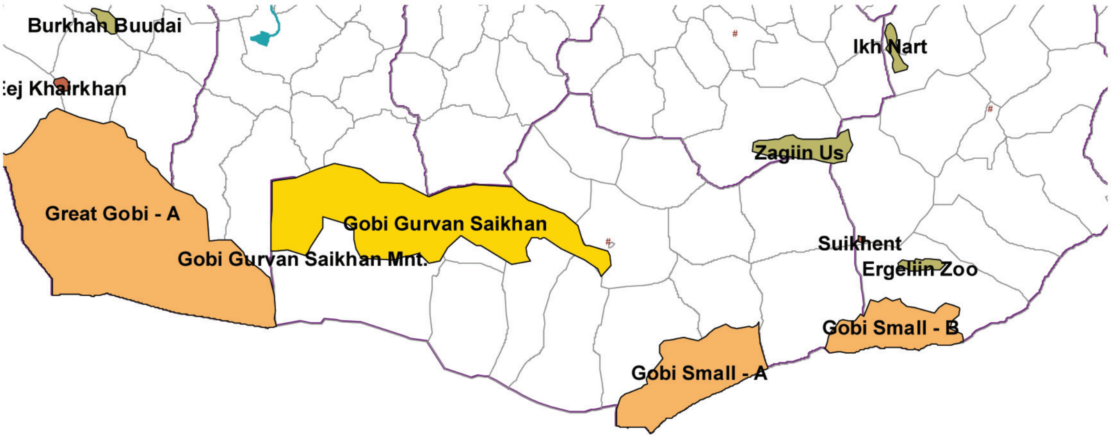
Protected areas	Type	Hectares
Tsagaan Shuvuut Mnt.	SPA	23432
Turgen Mnt.	SPA	122511
Altan Els	SPA	150245
Uvs Lake	SPA	441298
Khokh Serkh Mnt.	SPA	75795
Devel Mnt.	NR	10627
Mankhan	NR	82870
Siilkhem Mnt. - A	NP	69947
Siilkhem Mnt. - B	NP	77912
Altai Tavan Bogd	NP	659194
Khan Khokhii Mnt.	NP	223750
Khyargas Lake	NP	343460
Tsambagarav Mnt.	NP	116275
Khar Us Lake	NP	853667

South West



Protected areas	Type	Hectares
Great Gobi – B	SPA	925850
Khasagt Khairkhan Mnt.	SPA	28975
Bulgan River	NR	7932
Sharga	NR	313887
Burkhan Buudai	NR	50685
Alag Khairkhan	NR	36753
Myangan Ugalzat Mnt.	NP	63243
Eej Khairkhan	NHM	23115

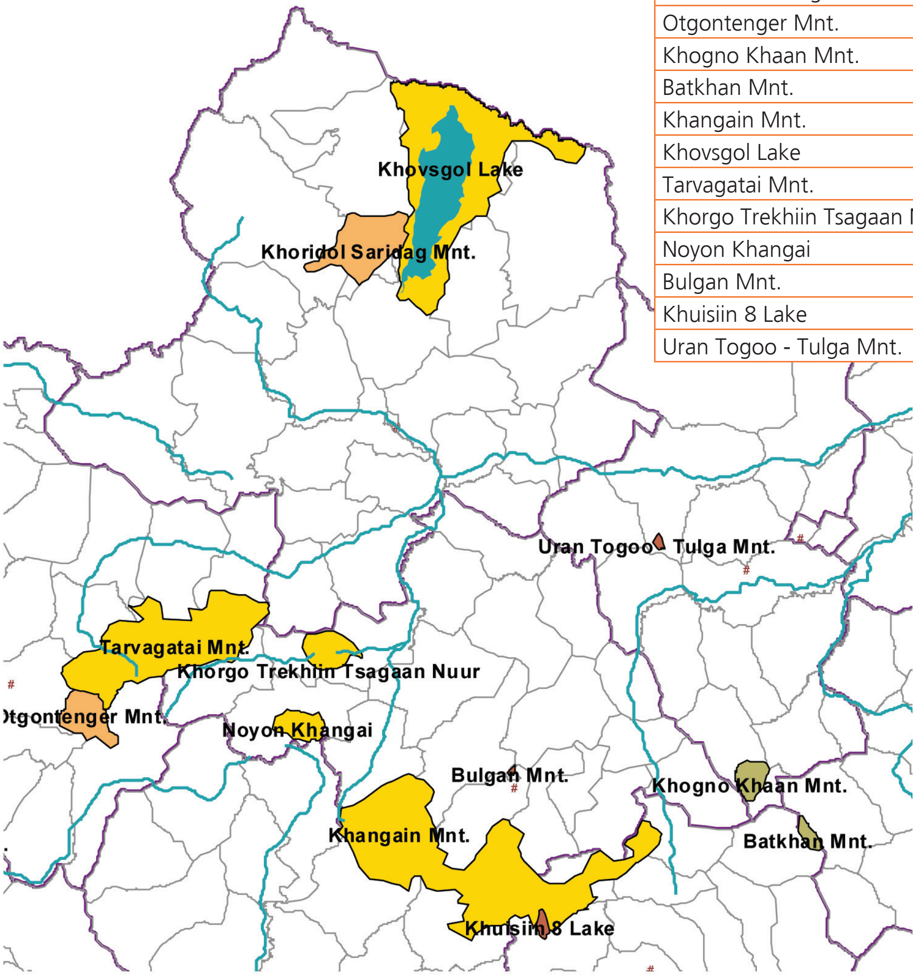
South



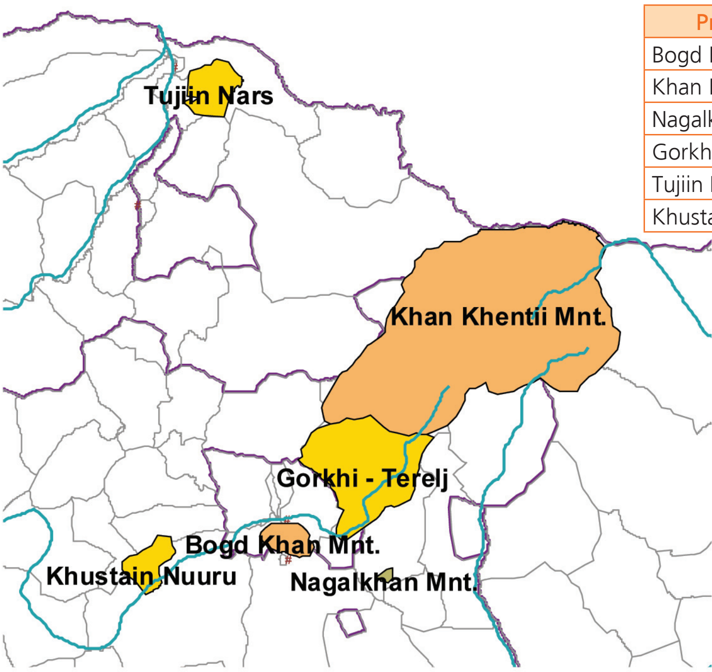
Protected areas	Type	Hectares
Great Gobi - A	SPA	4636943
Gobi Small - A	SPA	1150022
Gobi Small - B	SPA	691695
Zagiin Us	NR	273799
Ikh Nart	NR	66648
Ergeliin Zoo	NR	61118
Gobi Gurvan Saikhan	NP	2734099
Gobi Gurvan Saikhan Mnt.	NP	2
Suikhent	NHM	4937

Central North

Protected areas	Type	Hectares
Khoridol Saridag Mnt.	SPA	189177
Otgontenger Mnt.	SPA	92762
Khogno Khaan Mnt.	NR	46772
Batkhan Mnt.	NR	20668
Khangain Mnt.	NP	907693
Khovsgol Lake	NP	849946
Tarvagatai Mnt.	NP	540083
Khorgo Trekhiin Tsagaan Nuur	NP	76957
Noyon Khangai	NP	57849
Bulgan Mnt.	NHM	2002
Khuisiin 8 Lake	NHM	11158
Uran Togoo - Tulga Mnt.	NHM	5420

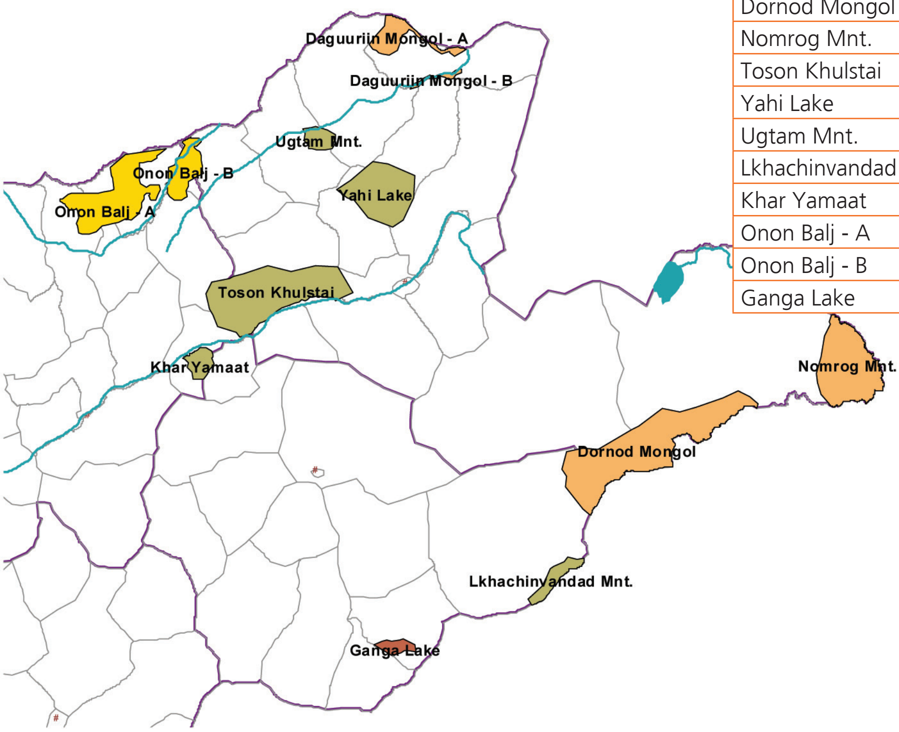


Protected areas	Type	Hectares
Bogd Khan Mnt.	SPA	41383
Khan Khentii Mnt.	SPA	1231145
Nagalkhan Mnt.	NR	5240
Gorkhi - Terelj	NP	292011
Tujiin Nars	NP	71740
Khustain Nuuru	NP	51246



East

Protected areas	Type	Hectares
Daguuriin Mongol - A	SPA	90368
Daguuriin Mongol - B	SPA	15287
Dornod Mongol	SPA	589026
Nomrog Mnt.	SPA	321102
Toson Khulstai	NR	458891
Yahi Lake	NR	251427
Ugtam Mnt.	NR	46060
Lkhachinvandad Mnt.	NR	59292
Khar Yamaat	NR	50333
Onon Balj - A	NP	295363
Onon Balj - B	NP	106470
Ganga Lake	NHM	32877



From: Biodiversity Assessment and Conservation Planning, WWF (2002)

SHORT DESCRIPTION OF SOME PROTECTED AREAS IN MONGOLIA

STRICTLY PROTECTED AREAS (SPA);

1. Khasagt Khairkhan

This mountain situated in Sharga, Jargalant sums territory of Gobi Altai aimag was initially protected as a strictly protected area in 1965 by PGH Presidium Resolution No. 17. It was approved as a strictly protected area in 1995 by Parliament Resolution No. 26 about 're-establishment of the state protected areas' classifications'. Its territory is 27448 hectares.

This area is a forested part of the Mongol Altai mountain range. Plants and wildlife of mountainous, steppe and Gobi regions inhabit here.

2. Bogdkhaan mountain

Bogdkhaan Mountain was officially protected, first, in 1778 by the initiative of Khuree Van Minister (a capital governor) Yundendorj, one of the leading aristocrats of that time. This mountain which is an ancient historical and cultural monument and is located near the capital was taken under protection by the PGH Presidium Resolution No. 31 of 1957 and given the name of "Choibalsan Mountain", then in 1974, it was designated as a strictly protected area by PGH Presidium Resolution No. 248 and given the name 'Bogd Uul". It occupies 41461 hectares of area. It was included in the category 'strictly protected area[1] by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas. This mountain is the southern part of Khentee mountains range, the borderline between forest steppe and steppe regions, the southern borderland of the larch forest, and is of a special significance in the climate formation of the surrounding area. Species here are characteristic of the taiga, mountain forest steppe, and steppe zone, including over 500 species of vascular plants, 9 trees, 47 mammals, 116 birds, 4 reptiles, and 2 amphibians.

Recognized as a sacred mountain, its history much related with religious civilization and settlements such as Manzchir Hiid monastery established in!750.

3. Great Gobi SPA

It was designated as a protected area in 1975 by PGH Presidium Resolution No. 84, and in 1995 it was approved as a strictly protected area by Parliament Resolution No. 26, and in accordance with the Law on Protected areas.

It consists of two parts: 'A' part includes Altai, Tsogt, Erdene sums of Gobi Altai aimag, and Bayan Ondor, Shine Jinst sums of Bayankhongor aimag; 1B' part includes Uyench, Altai sums of Khovd aimag, and Tonkhil, Bugat sums of Gobi Altai aimag; and occupies 5311730 hectares of land.

This area has kept its original conditions of Central Asian Gobi desert, and is a motherland of globally rare wildlife animals such as bactrian camel Gobi bear and Asiatic wild ass, Gobi gesco and tatar sand boa. Scientists have identified 410 species of plants, 49 species of mammals, 15 reptiles and amphibians and over 150 species in the protected area. In 1991 it was registered in the World's Man and Biosphere networks.

4. Khukh serkhyn nuruu

It occupies 65920 hectares of area of Deluun sum of Bayan-Olgii aimag and Khovd sum of Khovd aimag. It was protected by PGH Presidium Resolution No. 76 of 1977 and was approved as a strictly protected area by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas. This strictly protected area is the main habitat for argali and ibex herds, and also, is an area with a special significance in providing the ecological balance and in maintaining the original features of the Mongolian Altai mountain range.

5. Mongol Daguur

This area consists of 2 parts, where "A" part is Chuluunkhoroot sum territory of Dornod aimag and "B" part is a marginal area between Chuluunkhoroot, Gurvanzagal, and Dashbalbar sums. It was initially taken under the protection by PMH Resolution No. 11 of 1992, and then in 1995 it has been approved as a strictly protected area by Parliament Resolution No. 26. Us territory is 103016 hectares.

It contains special characteristics of wildlife, bio-diversity and geography. It was established with a purpose to protect the Daguur steppe, waters, marshes, and the world of wildlife and bio-diversity species that inhabit there. Its territory includes the strip area from the land along the Ulz river and mountain ranges along the state border till the Tari lake. This SPA is a borderland between 2 kinds of larch forests which occur in Mongolia. And the larch mixed of Sibirian and Daguur larches, which is of a great biological and economic importance, grow in here. In order to protect the migrating bird species, the Russian, Chinese and Mongolian joint strictly protected area was established in 1997. Also it was registered in the list of the Ramsar convention in 1994.

6. The Eastern Mongolian steppe

This area is located in Matad, Khalkhyn gol of Dornod aimag and Erdenetsagaan sum of Sukhbaatar aimag and is the only representative of the steppe land region which has not been impacted by economic activities. In order to protect the Khyalganat steppe ecosystem and the habitation of white gazelles, this area has been taken under state special protection by PMH Resolution No. 11 of 1992 and then by Parliament Resolution No. 26 of 1995 it was included in the category 'strictly protected area'. Its territory is 570374 hectares of area around Menen steppe and Lagiin khooloi.

Over 70% of white gazelle population of Mongolia inhabit here. This area represents the steppe complexity, which has preserved its original features, of not only the Mongolian eastern steppe but also the arid steppe of the Asian continent.

7. Nomrog

This area occupies 3 11205 hectares of area along the state border in Sumber sum of Dornod aimag and in the forested steppe and steppe regions of the low, average and high mountains in the western part of Khyangan mountain range. It was taken under state special protection in 1992 by PMH Resolution No. 11 and was approved by Parliament Resolution No. 26 of 1995.

This is the only area where one can see original conditions of Khyangan mountain range, which contains the specific structure and formation of Khyangan mountainous region, and peculiarities of its transition from forest steppe into Central Asian arid steppe region. This SPA has an objective to protect the ecosystem of Khyangan, and wildlife and biodiversity species of Manjuur. Regarding plants, this area has the Manjuur element which can not be found anywhere else in Mongolia.

8. Otgontenger

Otgontenger mountain, a highest peak of Khangai mountain, is situated in Otgon and Aldarkhaan sums territory of Zavkhan aimag. Historically, this mountain was initially protected in 1818. In 1992, it was taken under special protection by PMH Resolution No. 11 with a territory of 95510 hectares, and in 1995 it was approved by Parliament Resolution No. 26.

This area represents the natural complexity of Khangai mountain range and is a motherland of rare and very rare wildlife and bio-diversity species.

9. Khan Khentee Nuruu

Khan Khentee SPA, which is situated in the territory of Erdene and Mongonmort sums of Tov aimag, Batshireet and Omnodelger sums of Khentee aimag, and Eroo and Mandal sums of Selenge aimag, and occupies 1227074 hectares, was taken under special protection in 1992 by PMH Resolution No. 11. In 1995, it was included in the category 'strictly protected area' by Parliament Resolution No. 26.

Khan Khentee mountain range has preserved its original features, and is located between Eurasian coniferous forest taiga and Central Asian arid steppe. Also it feeds big rivers such as Tuul, Onon, Kherlen, Kharaa, Eroo, etc.

Khan Khentee mountain range represents basic characteristics of a natural zone, and includes 5 kinds of landscapes of real taiga. This area becomes an old historical monument of Mongolians.

10. Uvs Lake basin

This SPA occupies 712545 hectares of area and consists of Uvs Lake part - located in the territory of Tes, Davst, Malchin, Naranbulag, Tarialan sums of Uvs aimag, Allan Els part - located in the territory of Baruun Turuun sum, Tsagaan Shuvuut part -located in Sagil sum territory, and Turgen Uul part -located in Turgen, Tarialan, Bokhmoron. Khovs sums territory. It was established in 1993 by Parliament Resolution No. 83.

This area is of special geographic landscape that reflects all characteristics of horizontal basin region, which does not flow outside of Central Asia. This strictly protected area consists of:

- Uvsnuur, Torkhilog, Tesiin gol adag,
- Tsagaan shuvuut,
- Altan Els,
- and Turgenii Uul, which are extremely different in terms of nature, the environment, landscapes, and are located close to each other.

11. Small Gobi SPA

This SPA consists of "A" and "B" parts and occupies 1839176 hectares of land in Nomgon, Bayan-Ovoo, Khanbogd sums territory of South Gobi aimag, and Borzon, Zeemgene, Kharmagtain Gobi areas, which are the southern part of Khatanbulag sum of Dornogobi aimag. In 1993, it was established as a strictly protected area by Parliament Resolution No. 83.

This area represents main characteristics of the east-southern Gobi region of Mongolia and has relatively preserved its original natural features and conditions. It is the main habitat for rare and very rare wildlife animals of the world, such as khulan (wild ass), black-tailed gazelle, argali (mountain sheep), and ibex. About 50% of the khulan population of our country occur in this area.

12. Khordol Sardag Nuruu

This area covers the territory of Ulaan-uul, Renchinlkhumbe sums of Khovsgoi aimag and occupies 188634 hectares of land. It was taken under state special protection in 1997 by Parliament Resolution No. 47.

It has characteristics of horizontal region, such as tundra, taiga, forested steppe and mountainous area, which are greatly different in terms of nature, the environment and landscape, but are located close to each other. Due to this characteristic, it becomes the habitation of many bio-diversity species of tundra soil, which have become rare and very rare, (S.involucrata, A. altaicum Pall, etc), and wildlife species (argali, ibex, sibirian moose, snowcock, sable, etc). There is a part of argali and ibex population occur in here, which is an unusual thing.

THE NATIONAL PARKS (NP):

l.Khorgo-Terkhiin Tsagaan Nuur

This beautiful place, which is located in Taryat sum territory of Arkhangai aimag, was taken under protection by PGH Presidium Resolution No. 17 of 1965, and by Parliament Resolution No. 27 of 1995, the area comprising 77,267 hectares of land was designated as a national park, in accordance with the Law on Protected Areas.

This area is of special formation, such as rocks created due to volcano eruption.

2. Khovsgol

This national park comprises of the territories of Alag-Erdene, Renchinlkhumbe, Tsagaan Uul, Khankh and Chandmani-Ondor sums of Khovsgol aimag. This NP covering 838,070 hectares was taken under special protection in 1992 by PMH Resolution No. 11 and was classified as a NP by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas.

It has been purposed to represent the taiga regional complexity, to protect the Khovsgoi lake basin, to develop the eco-tourism, and to conduct surveys and studies.

3. Gobi Gurvansaikhan

The Yolyn Am was initially protected in 1965 by PGH Presidium Resolution No. 17, and then in 1993 by Parliament Resolution No. 83, its territory was extended by further including the territories of Sevrei, Bayandalai, Bulgan, Khankhongor, Khurmen, Gurvantes sums of South Gobi aimag, which comprise 2171737 hectares of area, and was approved as a national park. By Parliament Resolution No. 26 of 1995, it was approved.

It can represent main natural characteristics of Gobi-Altai mountain range. It has various landscapes, such as high mountains, mountain valleys, arid steppe and desert. The main orientation is to carry out tourism activities in Gobi regions through the sustainable way .

4. Gorkhi-Terelj

This NP comprises 293,168 hectares of area of Erdene sum, Tov aimag. It was formed in 1995 by Parliament Resolution No. 83.

. It can represent the south complex of Small Khentee mountain and is suitable for managing tourism activities.

5. Khustain Nuruu

This area was established as a nature reserve by Parliament Resolution No. 83 of 1993, and as a national park by Parliament Resolution No. 115. Its territory comprises of 49940 hectares land of Altanbulag, Argalant, Bayankhangai sums of Tov aimag.

This area represents characteristics of steppe regions of the west-southern part of Khentee mountain range. Due to its sufficiency of fodder and water resources, as well as geographical suitability, the takhi (wild horses) from the Takhi Protection Foundation of Holland and Askani-Nova of Ukraina are re-introduced in this area.

6. Altai Tavan Bogd

This area has a territory of 636161 hectares along the border of the western part of Ulaan Khus, Tsengel, Sagsai, Altai sums of Bayan-Olgii aimag. It was taken under protection in 1996 by Parliament Resolution No. 43.

This National park has beautiful nature and represents special characteristics of high mountainous, icy rivers, mountain valleys, steppe landscapes and ecosystems. Also, it is a habitat for mammals, like argali, ibex, maral, deer, and bird species, like snowcock, eagle, lammergeyer.

This area is suitable for developing mountain sport and eco-tourism.

7. Khangain Nuruu

This area comprises of the central part of Khangai mountain range which is a border crossing area between Chuluut, Bulgan, Tsenkher, Khotont, Ikh Tamirof Arkhangai aimag, Kharkhorin, Khujirt, Bat-Olzii, Uyanga sums of Ovorkhangai aimag, and Erdenentsogt, Galuut sums of Bayankhongor aimag. It was taken under protection in 1996 by Parliament Resolution No. 43 and covers 888,455 hectares of land.

This area has kept original features of its natural complexity of Khangai mountain, and is a composition of an amazing mixture of natural landscapes. It is a partition of the world's watershed. Also, it is of a special significance in the water and climate change in Mongolia, and in maintaining ecological balance.

8. Khar Us Nuur

This area comprises of 850272 hectares of Myangad, Dorgon, Chandmani, Mankhan, Buyant sums of Khovd aimag. By Parliament Resolution No. 47 of 1997, it was designated as a national park.

This NP is located near Ikh Nuuruud lowland covering a large area of desert steppe and arid semi-desert environment, and plays a decisive role in the climate formation and composes a special ecologic environment. It is a habitation of rare and very rare wildlife species. Also, it is the unique natural place which is composed of mountains with fresh water resources of our country, Gobi desert, steppe valleys, and the Mongolian Altai Mountains covered with snow.

This NP was registered in the list of the Ramsar Convention in 1999 due to its suitable environment for water and marsh bird species to live.

9. Noyonkhangai

This NP with a territory of 59,088 hectares of Khagain sum of Arkhangai aimag was established by Parliament Resolution No. 28 of 1998.

This area is a special and beautiful formation of nature and is a habitation of many rare and very rare wildlife and bio-diversity species. There are many mineral waters and springs. Since ancient time, there has been followed a historical tradition to worship this area.

NATURE RESERVES (NR):

1. Batkhaan

It was initially protected by PGH Presidium's Decree in 1957. This area is located in Burd sum territory of Ovorkhangai aimag and Erdenesant sum of Tov aimag. It was designated as a nature reserve comprising 58800 hectares by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas.

It is a component of the Khangai and Khentee mountainous state and is an ancient historical and cultural monument.

2. Nagalkhaan Uul

It was initially protected in 1957. According to the new law on Protected Areas and by Resolution No. 26, this area was designated as a nature reserve. It is located in Erdene sum territory of Tov aimag covering 3076 hectares of land.

It is the southernmost part of Khentee mountain range and the pine forest.

3. Bulgan gol

The area, a strip of land with beaver between Bulgan sum territory and Bulgan river of Khovd aimag, was initially designated as a protected area by PGH Presidium Resolution No. 17 in 1965. In 1995, it was included in the classification "nature reserve" with the territory 1,840 hectares by Parliament Resolution No. 26, in accordance with the law on Protected Areas.

There many various wildlife species inhabit in this area. The very rare wildlife species such as beaver, black sable with silver tip, stone marten, Mongolian agama, etc occur here. This NR is purposed to study and to breed beavers.

4. Lkhachinvandad Uul

It is located 75 km to the south from Erdenetsagaan sum center of Sukhbaatar aimag. By PGH Presidium Resolution No. 17 of 1965, the area of 750 sq. km was initially designated as a protected area. In 1995, this area was included in the classification "nature reserve" with territory 58500 hectares by Parliament Resolution No. 26, in accordance with the law on protected areas.

This area is a habitation of mountain deer, and is a mountain steppe with no forest. There grow many species of steppe bio-diversity.

5. Ugtam Uul

This low mountain, which continues from the west-south to the east-north and along the Ulz river in Dashbalbar and Bayandun sums territory of Domod aimag, was taken under special protection by Parliament Resolution No. 83 of 1993.

It is a beautiful place located in the frontier area between forest steppe and steppe regions, and can represent the natural complexity. It is specific that the Dornod part forest border is pushed in to the south.

6. Sharga-Mankhan

It consists of 2 parts, one of which is Mankhan part located in Buyant, Mankhan sums territory of Khovd aimag, and the other one is Sharga part located in Tonkhil, Darvi, Togrog, Khaliun sums territory of Gobi-Altai aimag. The distance between these two parts is about 200 km. It was approved by Parliament Resolution No. 83 of 1993 with the territory 390071 hectares. It is the last origin place of the Mongolian antelope, one of two antelope sub-species that exist on the world. Therefore, this NR is purposed to protect and to breed antelopes.

7. Alag Khairkhan

It comprises of 36400 hectares of Bugat sum territory of Gobi-Altai aimag. This area was taken under special protection in 1996 by Parliament Resolution No. 43.

It is one of the high mountains of the middle part of Mongol Altai mountain range, and is a habitation of rare and very rare bio-diversity species (S. involucrata; serjmyadag; D. superbus), and wildlife species (argali, ibex, snow leopard, and snowcock).

8. Burkhan Buudai

The Burkhan Buudai Nature reserve covers 52110 hectares of land in the marginal area between Biger, Tsogt and Khaliun sums of Gobi-Altai aimag. In 1996 it was taken under special protection by Parliament Resolution No. 43.

Many small local rivers take sources from here. There are many naturally created special places. Local people have been worshipping the brown stone which is located at the top of low bogd mountain and looks like a wheat.

9. Ikh Nart

The Ikh Nart nature reserve, which covers 43740 hectares of land between Dalanjargalan and Airag sums of Dornogobi aimag, was established in 1996 by Parliament Resolution No. 43. Because it is the east-northernmost part of argali habitation, it was purposed to extend the argali distribution and to protect the special formation of nature and the environment.

10. Zagiin Us

This nature reserve covers 273606 hectares of land between Olziit sum of Dundgobi aimag, Mandakh sum of Dornogobi aimag and Manlai sum of South Gobi aimag.

The Zagiin Us valley is a mixture of saline soil, dry circular salt marsh, saxaul forest and sand dunes. It creates multilateral landscape conditions and ecological special environment. Also, it is the east-northern part of the saxaul forest distribution, the northernmost part of the black-tailed gazelle distribution, and the western part of the white gazelle distribution.

11. Ergeliin Zoo

The area, which covers 60910 hectares of land of Khatanbulag sum of Dornogobi aimag, has a special formation of nature and is abundant in archeo-logical findings, was included in the category "nature reserve" and taken under state special protection by Parliament Resolution No. 43 of 1996.

This place has kept the findings of the mammal animals which become the witnesses of the biological kingdom for over 30 million years ago. Many scientists have been studying this area and it has been recorded as "Altan Uul" in foreign books and magazines.

12. Khognokhaan

It covers 46990 hectares of land and is situated in Gurvanbulag, Dashinchilen, Rashaant sums of Bulgan aimag. This area was taken under state special protection in 1997 by Parliament Resolution No. 47.

It is specific that there grow taiga and steppe plants, at the same time. Also, it is specific that there are 2-3 different natural zones happened upon at the same place. There grow C. mongolicus Pojark which is famous as "Khogno, Tarnyn" within population.

13. Toson khulstai

This area occupies 469928 hectares of land of Bayan-Ovoo, Norovlin sums of Khentee aimag, and Kholonbuir, Tsagaan-Ovoo sums of Dornod aimag. It was approved in 1998 by Parliament Resolution No. 28.

Toson, Khulstai nuur, Salbaryn valley are the main habitats for white gazelles, and, with regard to this, it was purposed to extend the distribution of white gazelles to the north from the Kherlen river.

14. Khar Yamaat

This area occupies the territory of 50594 hectares of Bayan Ovoo sum of Khentee aimag and Tumentsogt sum of Sukhbaatar aimag. It was approved by Parliament Resolution No. 28 of 1999.

The surrounding area of Khar Yamaat and Turuu Ondor mountain has a special formation, which rarely occur in the steppe region, and is an ending continuation of Khan Khentee mountain range. This place is called "Khangai" and is apart of area, where grow pine and aspen groves, fruits and medicinal plants.

15.Yakhi Nuur

It was established by Parliament Resolution No. 28 of 1998, with an area of 251388 hectares between Sergelen, Gurvanzagal, Choibalsan sums of Dornod aimag.

It is the northernmost part of the white gazelle distribution, and is one of the main habitats for the migrating birds.

NATURAL HISTORICAL MONUMENTS (NM):

l. Bulgan Uul

This area was initially protected by PGH Presidium Resolution No. 17 of 1965 and, then in 1995, it was included in the category "monument" by Parliament Resolution No. 26 of 1995.

It occupies 1840 hectares of area of Tsetserleg sum of Arkhangai aimag. It is included in the mountainous belt with an atriat formation of the Mongol and Amar lake valleys and creates a special local micro-climate. This area is suitable for re-introducing sables.

2. Uran-Togoo-Tulga Uul

It is situated in Khutag-ondor sum territory of Bulgan aimag. This beautiful mountain was initially protected in 1965 by PGK Resolution No. 17, and then, in 1995 it was designated as a monument by Parliament Resolution No. 26. It covers 5800 hectares of area and is an inactive volcano with special nature formation.

3. Khuisiin naiman nuur

The area, which covers 11500 hectares around the lake located in the Uyanga sum territory of Ovorkhangai aimag to the west-south from Khangai mountain range and its surrounding area, was taken under state special protection by PMH Resolution No. 11 of 1992, and was included in the category "monument" by Parliament Resolution No. 26 of 1995.

It has a special formation and beautiful nature in the middle part of Khangai mountain range. Also, it is a valuable monument for geological and water studies. These lakes with fresh water and interconnected by the ground water channels such as Shireet, Khaliut, Bugat, Khaya, Khuis, Onon, Doroo, Bayan-UuI, are called Khuisiin Naiman Nuur (Khuisiin Eight Lakes).

4. Eej Khairkhan Uul

It is located between Tsogt and Altai sums of Gobi-Altai aimag, the west-southern part of Mongolia. This area was protected in 1992 by MK Resolution No. 11, and in 1995, was included in the category "monument" with the territory 22475 hectares by Parliament Resolution No. 26 of 1995.

The 9 green-framed stone pots which are set aside the deep rocky strip near the solitary mountain which is cut off the Gobi Middle Mountains, and in the western side of Eej Khairkhan mountain, very much attract the interests of nature lovers and conservators. When the first pot is filled up, it creates a little waterfall by pouring the excessive water to the next pot through the stone threshold which is 40-50 cm long.

5. Ganga Nuur

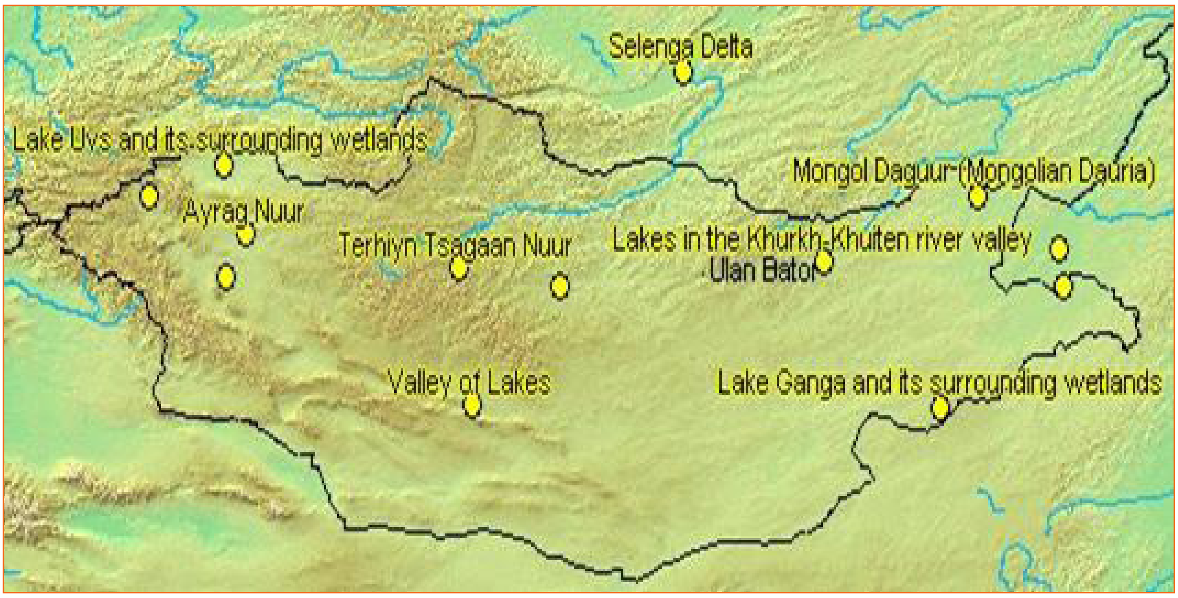
The area" surrounding the lake which was formed by the sand block created by the wind movement, with a territory 32860 hectares was designated as a monument by Parliament Resolution No. 83 of 1993. It's a beautiful lake with fresh water and is located between the mountainous steppe and Gobi regions. It composes the special local climate.

6. Suikhent

This area covers 4830 hectares of Mandakh sum territory of Dornogobi aimag. It was taken under protection by Parliament Resolution No. 43 of 1996.

This area has a rare natural formation with petrified trees which does not often occur in Mongolia.

Ramsar sites of Mongolia



Source of map: http://ramsar.wetlands.org (database)

Nr	Name	Date	Aimag	Area	Location
1	Ayrag Nuur	13/04/99	Hovd	45,000 ha	48°53′N 093°25′E
2	Har Us Nuur National Park	13/04/99	Hovd	321,360 ha	47°58′N 092°50′E
3	Lake Achit and its surrounding wetlands	22.03.04	Bayan-Ulgii, Uvs	73,730 ha	49°40′N 090°35′E
4	Lake Buir and its surrounding wetlands	22.03.04	Dornod	104,000 ha	47°48′N 117°40′E
5	Lake Ganga and its surrounding wetlands	22.03.04	Sukhbaatar	3,280 ha	45°15′N 114°00′E
6	Lake Uvs and its surrounding wetlands	22.03.04	Uvs	585,000 ha	50°20′N 092°45′E
7	Lakes in the Khurkh-Khuiten Valley	22.03.04	Khentii	42,940 ha	48°18′N 110°34′E
8	Mongol Daguur (Mongolian Dauria)	08/12/97	Dornod	210,000 ha	49°42′N 115°06′E
9	Ogii Nuur	06/07/98	Arkhangai	2,510 ha	47°46′N 102°46′E
10	Terhiyn Tsagaan Nuur	06/07/98	Arkhangai	6,110 ha	48°10′N 099°43′E
11	Valley of Lakes (Boon Tsagaan Nuur, Taatsiin Tsagaan Nuur, Adgiin Tasgaan Nuur, Orog Nuur)	06/07/98	Bayankhongor	45,600 ha	45°19′N 099°58′E

Ayrag Nuur. A shallow, freshwater lake in the Mongolian Great Lakes Basin. An exceptionally important breeding and resting site for a variety of waterbirds and the only remaining place in Mongolia where the Dalmatian Pelican regularly comes to breed. The lake is of fundamental importance for the groundwater recharge of the area.

Har Us Nuur National Park. Three large but shallow lakes - Har Us Nuur, Har Nuur and Dorgon Nuur. Vast reedbeds and extensive aquatic plant communities provide a suitable habitat for a large number of breeding and migratory waterbirds. The lakes are of fundamental importance for the groundwater recharge of the area, and are of social and cultural significance because of the presence of a number of sacred places and archeological sites.

Lake Achit and its surrounding wetlands. Freshwater shallow lakes in the Khovd River basin, with the Achit Lake being the largest in the Mongolian Altai range. The site, lying in an intermountain basin at 1435m, includes Devel State Nature Reserve to the south (1,030ha). Lakes are frozen from November to May.

Lake Buir and its surrounding wetlands. The largest freshwater lake in eastern Mongolia, part of the basin of the large Amur River, together with many associated small lakes - northeastern parts of the system outside the Ramsar Site boundary lie across the border with China. This transitional habitat between Daguur and Stipa steppes features flora and fauna characteristic of arid steppe; it regulates the Khalk gol River and the Buir lake's water regime and protects the origins of many small rivers, lakes, streams, and springs.

Lake Ganga and its surrounding wetlands. Natural Monument Area. A small brackish lake (220ha) and associated lakes in eastern Mongolia within a unique landscape combining wetlands, steppe and sand dunes, located in the strip between the south steppe and Gobi zones. This lake district is based in the wind-scoured lowlands of extinct volcanoes and known as *Dariganga.*

Lake Uvs and its surrounding wetlands. UNESCO Biosphere Reserve. The largest saline lake in Mongolia with a small part lying in Russia, a unique wetland in desert-steppe landscape fringed by high mountain ranges; it has a maximum depth of 20m and freezes over from November to May.

Lakes in the Khurkh-Khuiten river valley. Permanent lakes located in the transition zone between Mongolian forest and steppe zones in the basin of the Khurkh-Khuiten River, a tributary to the great Onon River.

Mongol Daguur (Mongolian Dauria). Set in a basin formed by tectonic and volcanic activity, the site includes vast steppes, marshy wetlands, rivers and lakes. Supports a high species diversity with many endemic or rare plants. Semi-nomadic, animal husbandry is the principal livelihood of the local population. Crop production is also practiced.

Ogii Nuur. A freshwater lake located in the valley of the Orkhon River, comprising extensive alluvial areas of grassland, river channels, pools and marshes surrounded by grassy steppe. The maximum depth of the lake is 16 meters, but about 40% of the lake is less than 3m deep. The lake supports an intensive fishery and livestock grazing. It is a very important breeding and staging area for a wide variety of waterfowl.

Terhiyn Tsagaan Nuur. A freshwater and nutrient-poor lake formed by volcanic activity, located in the Suman River valley in the Central Khangai Mountains. As with most wetlands in Mongolia, land use in and around the lake is restricted to fishing and livestock grazing. The extensive marshes in the west are an important breeding and staging area for migratory waterfowl.

Valley of Lakes (Boon Tsagaan Nuur, Taatsiin Tsagaan Nuur, Adgiin Tasgaan Nuur, Orog Nuur). A chain of four saline lakes at the foot of the Gobi Altai, ranging from 1100m to 1235m in altitude. The lakes are shallow, with a saucer-shaped depth profile, and vary considerably in size both seasonally and from year to year. These lakes are known to be an important staging area for migratory waterfowl, and it has been suggested that they might be a breeding area for the rare Relict Gull. The lakes provide grazing land for domestic livestock in an otherwise arid region.

Part 3.
WATER QUALITY AND ECOLOGICAL ASSESSMENT

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Introduction

Mongolia's location, size and topography provide for a unique assembly of ecosystems or natural zones, from glaciers and fresh water streams to brackish lakes and arid deserts. Due to the extremely low population density in most parts of the country, some of the most pristine and untouched ecosystems exist in its territory, harboring a multitude of endemic species that have adapted to the harsh or very specific conditions. This combination of the variety of ecosystems and the low anthropogenic impacts give to Mongolia a high ecological value and bring profit to the population.

Aquatic systems bring a multitude of benefits, called “ecological services”, to the society. Drinking resources for human uses, self-purification capacity, attractiveness for tourism, and valuable fish populations for instance depend on proper natural ecological conditions. Proper management of water quality and ecosystems is required to ensure the sustainability of these services.

The increasing population and economic activity add to the impacts of climate change and trigger a variety of general or local modifications on water quality and aquatic ecosystems. Although we may be able to fairly accurately measure the pollution or changes in a system, it remains quite difficult to determine the extent to which the various anthropogenic uses cause these changes and the vulnerability of the ecosystems to these changes.

The main objectives of this report is to assess the current state of the ecological conditions in Mongolia, to determine the main pressures on the ecosystems and to qualitatively describe their impacts, not only on the ecological conditions but on the services they provide to society as well.

1. Available Data and Information Used

1.1. Water Quality Data and Their Sources

The environmental monitoring network of the Ministry of Nature and Environment comprises approximately 140 sampling points for analyzing surface water quality in 72 rivers and 9 lakes, 20 sampling sites for analyzing waste water from waste water treatment plant and 22 sampling points for precipitation. Not all sampling data could be accessed for this report.

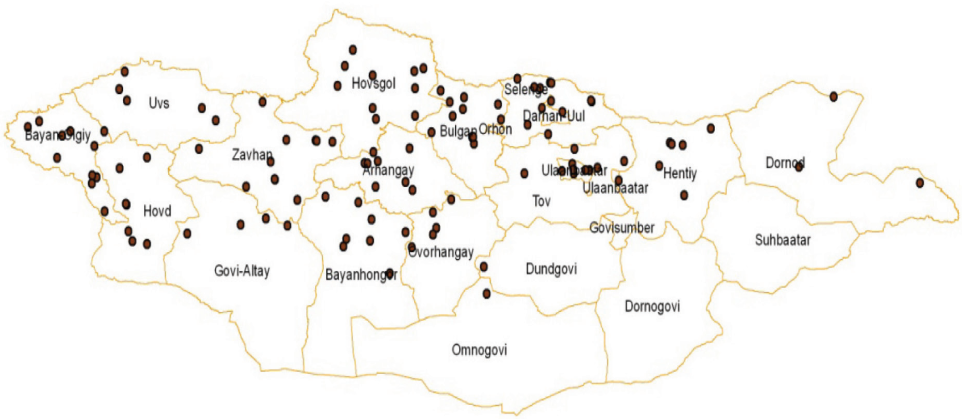

Figure 1. Surface water monitoring stations

The Asia Foundation has started a monitoring program for surface water quality and macro-invertebrates, but till date monitoring data are not yet available. Several ad hoc monitoring activities have provided data on surface water quality however most of these studies focus on areas with severe impacts from human activities (e.g. mining sites).Only very few monitoring points exist in areas not affected by human activities that could serve as a control for assessing the impacts of human activity.

The availability of data on heavy metals concentrations is very limited, mostly as results of ad hoc studies during a short period of time, thus making it difficult to establish a reliable trend. Data on bacteriological analysis, for surface and groundwater, are difficult to get access to and data on sediment balance, granulometry, and river morphology are not available.

Data on groundwater quality are available for the period 1970 to 1991, for a number of locations. Data were recorded for shallow and deep wells, and include data on mineral composition, pH, and sometimes nitrogen based molecules such as nitrite, ammonium, and nitrate. As mineralization of the aquifer does not change significantly within a few decades, we can assume that these data reflect roughly the current mineralization of the groundwater. Concerning nitrogen based molecules the available data are not sufficient to define trends. It should be noticed that some data shows absurd figures (e.g. pH < 2); most of them have been corrected or discarded but there is uncertainty concerning the reliability of certain data. A careful approach has hence been done concerning analyses and conclusions related to groundwater quality.

Though a lot of data has been collected throughout the past decade, there is much room for improvement of the organization and the exchange of data between local level, national parks, institutes, and state agencies.

Table 1 Data source on water quality

Data type	Data source	Name of contact	Description	Availability status
Surface water quality data	Envir. Laboratory: database	Erdenebayar	14 monitoring points, monthly data from 1986: general substances, cations and anions and heavy metals	Available
	Asian Foundation: database	P.Tamir	Data from 2007, 2008 and 2009	Not available for all the stations
	Korea Environment Institute / Mongolian Nature and Environment consortium	Suh Sung Yoon	Data in the Arctic Ocean basins (2005 and 2006)	Available
Ground water quality data	Geo-Ecology Institute IWRM Project	G.Dolgorsuren	Data on mineral concentrations, pH, NH_4, NO_2 and NO_3 from 1960 to 1991, depending on locations	Available

1.2 Ecological Data and Their Sources

The monitoring of ecological conditions considerably improved during the last decade. Studies cover an array of ecological issues such as land cover degradation, changes in river regime, distribution of species, etc.

However, due to the immense size of the territory that needs to be covered and the relatively recent efforts on this subject, the information is still scattered, constraining efforts to put together a detailed picture of the ecological conditions and their recent changes in each river basin. Moreover there is little information on undisturbed areas that could be used as references. Local studies do bring out valuable information that, to some extent, can be extrapolated to the river basins.

The main documents on a national and river basins levels are detailed in Table 2. Other sources are reported in references at the end of this report.

Table 2 Data sources for Ecology

Data type	Data source	Name of contact	Description	Availability status
Protected area data and specific sites	MNET	Namhai	Planning and provincial protected area data	Available
	NGIC	Hudulmur	Provincial protected area data	Available
	RAMSAR bureau	Ouyngerel B.	Description of ecologically important wetlands sites (RAMSAR sites)	Available
River Basin(s) study case	MoMo project	Dietrich Borchardt	Kharaa river case study	Available
	WWF	Oyunmunkh Byambaa	Description of ecological changes in the Great Lakes basins region	Available

Data type	Data source	Name of contact	Description	Availability status
Biological data (fish, insects, birds, vegetation)	Asian Foundation	Angie Woo	Physical assessment of riverine conditions for Tuul and Orkhon	Available
	IUCN / Institute of Geo-Ecology	Mendsaikhan	Mongolian Red book of Fish and Summary Conservation Action Plans for Mongolian Fishes Mongolian Red List of Reptiles and Amphibians (List of endangered species and their locations in Mongolia)	Available
	Directory of Important Bird Areas	Nyambayar	Important Bird Areas in Mongolia: Key Sites for Conservation (List of area recognized as Important Bird Areas (IBAs) and their bird populations)	Available
Fisheries	FAO	Dulmaa A.	Description of the fisheries and fish stocks in Mongolia (1991)	Available

1.3 Reports and Other Documents and Their Sources

To assess the recent changes for human activities, many studies and reports have been collected concerning socio-economic activities. Many of the reports were based on a national level and did not fit well with our approach based on river basins. Other reports focus on aimag or sum level. Conclusions of such studies may have been (with the necessary caution) extrapolated to neighboring areas.

The projections described in [3] have been taken into account to evaluate the impacts of climate change. The census on lakes, rivers and springs carried out by the MENT every 4 years since 2007 has not been taken into account, due to the low representativity of this survey. Occurrence of lakes and springs are indeed too linked to the natural variability of the climate to obtain a clear picture of recent changes.

2. Methodology

2.1. Water quality

Surface water quality can be defined by physical characteristics such as temperature, suspended solids and turbidity, chemical characteristics like nutrients, minerals, metals, oxygen, organic compounds and a wide range of pollutants, and biological characteristics such as the types and quantities of bacteria and algaes.

There are various protocols for sampling and analysis in use, each of which can have a specific and significant effect on the results. Therefore homogeneity of the methods and protocols is a necessity to enable fair comparison and assessment of the conditions of aquatic ecosystems and the effectiveness of environmental policies and management practices. The Mongolian National Standard (MNS 4586-98), was developed by the Centre of Standardization and Measurements in 1998 [1] (Annex 1), is in force and includes 27 variables.

Water quality varies considerably throughout the year, related to discharge, climatic conditions, and human activities. In order to obtain a realistic view on surface water quality and to evaluate trends, monitoring data must be collected at different times of the year on the same sites. However surface water sampling can not reveal all the physical and biological conditions of the surface water system. In addition surface water assessment studies on sediments, habitats and biological composition are also necessary to obtain a complete understanding of the environmental conditions and their changes.

2.1.1. Water quality standard

With respect to the Water Quality Standard of Mongolia it must observed that the upper limit for nitrite concentration (0.002 mg N/L or 0.0066 mg NO_2/l) is very low compared to the standards used in other countries (for instance France: 0.1 mg/l, Canada: 0.06 mg/l and Russia: 0.08 mg/l). Although it is hard to determine the toxic concentrations of nitrite for humans or for fish, it is generally accepted that nitrite concentrations below 0.02 mg/l do not have a toxic effect on aquatic species [2]. The exceptionally low standard for nitrite in Mongolia may cause some misinterpretation of water quality. With nitrite concentrations appearing to be the dominating downgrading factor, attention is likely being diverted away from other (possibly more dangerous) pollutants.

On the other hand, the standard for mercury concentrations in water is high in Mongolia (0.1 mg/l) as compared to standards elsewhere (e.g. 0.001 mg/l in the United Kingdom), whereas signs of toxicity from mercury have been reported to be as low as 0.16ug/l (0.00016 mg/l) for fish larvae. The standards limit for permissible mercury concentrations would require a review, especially in the light of it becoming an emerging issue for water quality in Mongolia.

2.1.2. Surface water classification and Index

A multitude of parameters come into play for the assessment of water quality. Numerous tools are in use, mostly classification systems, to reduce and simplify the large amount of information, to make it easier to handle and understand. As any classification generates a loss of information, it has to be remembered that these tools can not entirely reflect the quality of the surface water, but are methods to provide a quick overview of the general condition of water quality.

A surface water classification was established in 2006 in Mongolia and categorizes surface water quality in 5 classes, from “very fresh” to “very polluted”, which are determined on the basis of assessing 53 factors distributed over 7 categories (Annex 2). Due to inadequate equipment often several parameters are not analysed, while some of the parameters, such as “color” and “odor” could be taken out of the list as their assessment is very subjective and provides no useful information.

A classification system defines various classes based on thresholds, while water quality standards contain a single permissible concentration or level or a range of permissible values. A classification system is objective and can be used to identify the condition of a system, while a standard is used to judge whether the systems condition is sufficient or not. The classification helps to identify surface water zones with similar water quality conditions. However, as any other classification system, it simplifies and reduces the information we obtained from water sampling and analysis.

Surface quality index:

The surface water quality index W_{qi} is defined as a simple expression of a more or less complex combination of a several parameters which serves as a measure for water quality. It is estimated by the following equation:

$$W_{qi} = \frac{\Sigma_i\left(\frac{C_i}{Pl_i}\right)}{n}$$

where C_i is concentration of i^{th} pollutant, Pl_i is the maximum permissible level of i^{th} pollutant in accordance with the National Standard Agency (1998), and n is the total number of pollutants.

Table 3 Water Quality Index

Water Quality Classification	Water Quality Index
Very Clean	<0.3
Clean	0.3 - 0.89
Slightly polluted	0.9 - 2.49
Polluted	2.5 - 3.99
Very polluted	4 - 5.99
Dirty	6 - 9.99
Very dirty	>10

The parameters are chosen according to the importance of assessing water quality and the availability of data in monitoring. The surface water quality index can be useful for comparing the quality of different waters and for assessing the effects of pollution. However there is often no information about the parameters that are taken into account and this can generate a wrong interpretation of the evaluation of the results.

2.1.3. Toxic compounds in biological tissues

Analyzing the concentration of toxic elements at very low concentration in surface water (for instance heavy metals) can be quite difficult because, unless very sensitive and accurate (and very expensive) equipment is used, the results will be very unreliable. As vegetal and animal species take in and bioaccumulate this compounds (see box below), higher and hence more easily detectable concentrations of these compounds can be found in their tissues. There are other advantages to this method as well; analyzing the tissues can bring us valuable information on the length of exposure to toxic compounds, some fish species cover a wide territory and can be representative of a whole section of a river. Complemented with water analysis, this provides us with information on the capacity of transferring toxic compounds from water to life-forms, and possibly to humans.

Bioaccumulation:

Heavy metals have a low solubility in water but have the capability to accumulate through the food chain in the aquatic ecosystems. This process is known as bioaccumulation.

Heavy metals are mainly bound to sediment particles rather than dissolved in water. Alkaline values limit even more the mobility of heavy metals in the water. However polluted particles can be moved downstream with the flow and cover the floodplains during floods. Thus, if the direct intake of heavy metals from water is fairly limited, contamination of aquatic plants or grass can occur and heavy metals can accumulate in organisms which feed on vegetals. The concern is significant regarding livestock as heavy metals are known to accumulate in fatty compounds such as milk and meat, which are often the most consumed products in rural areas. A chronic intake of heavy metals, even at low concentrations in these products, can trigger some serious health problems of food safety and endanger the economy based on pasture.

2.2. Groundwater quality

2.2.1. Groundwater quality standard

There is no separate groundwater quality standard in Mongolia. Water quality standards are applied according to the use of groundwater, such as the drinking water standard, livestock watering standard and irrigation water standard.

The MNET has requested a group of specialists to prepare a new proposal for a groundwater quality standard.

2.2.2. Groundwater quality classification

There is no groundwater classification in use in Mongolia. The water quality is classified according to the Water Quality Standard. This means that substances found in the water are classified as being above or below the appropriate water quality standard. A groundwater classification is available from “Hydrogeology of Mongolia” by N.A Marinov, P.N Popov, published in Russian, but this classification is not formalized and rarely used.

2.3. Ecological classification

Several attempts have been made to define the degree of “naturalness” of an ecosystem, to assess the extent of changes due to human activity. Many methods are based on assessing the difference between the current state of the system and what it would be in the absence of impacts. Recently methods have been developed for water management that are based on physical parameters (particle size of the river bed, morphology of the river, etc.), or biological parameters (distribution and population of macro-invertebrates and fish). Defining the state of degradation of an ecosystem in relation to its pristine condition is a complicated task. The variability and the complexity of the system, the difficulty to select representative stations (usually the number of stations is very limited and the location already fixed – on other than ecological grounds), and the lack of pristine reference contribute to disputable results.

Natural ecological conditions depend first on a good distribution of habitats. Aquatic ecology is a complex system subject to many processes such as varying flows, floods, changing bed morphology, sediment transport, and vegetation dynamics in the floodplain. This variety in habitats generates biodiversity. Evaluating the habitats requires methodologies specifically adapted to the local conditions. The available information on ecological conditions is inadequate to carry out a proper classification of the ecological state on sections of river basins.

The assessment of the biological elements provides valuable information on the ecological conditions as they are indicative for many parameters, such as water quality, variability of run-off, occurrence of specific habitats, etc. Furthermore they can reveal medium and long term pollution that cannot be derived from short monitoring time-series.

Analyzing the composition of macro-invertebrates provides valuable information on pollution and perturbations in the river beds, as some species only thrive in fresh water quality whereas others are much more tolerant. Most of the macro-invertebrates indexes are suited to describe organic pollution, however as it is described below most of the perturbations in Mongolia are caused by physical causes such as turbidity. No specific macro-invertebrate index has been developed yet for Mongolian conditions, but the Mongolian Aquatic Insect Survey project (Asia Center - Academy of Natural Sciences) is currently working on this subject.

The variety of fish species and the distribution of age classes provide information on the dynamics of the fish population. Like macro-invertebrates, some fish species have specific needs in terms of water quality, habitats, and river regime (e.g. salmonids as Taimen, and Mongolian Grayling). The loss of these species in favor of more tolerant species of fish, or a reduction in occurrence of young fish provides information on a degradation of environmental conditions. To obtain a good basis for comparison with pristine conditions, it is necessary to carry out fish sampling in untouched areas with different characteristics (slope, altitude, temperature, run-off regime). Proper monitoring is not only needed to assess the current conditions but is also a necessity for evaluating the effectiveness of future remedial actions.

Many tools and protocols are in use to assess water quality and ecological conditions. The ecological management classification appreciates the ecological condition of the surface water systems in relation to the natural conditions. It may be used to describe the current ecological condition of surface water, but can also be used for planning of desired ecological conditions. These desired conditions may be achieved by applying the appropriate measures. However, one shall not forget that using indexes to simplify our perception of the current conditions does cause some degree of information loss. The use of such indexes should be complemented with a more detailed assessment on the factors of degradation.

2.4. Impacts of climate change

Impacts of climate change on water quality and ecological conditions are qualitatively assessed in this report. Due to the high natural variability of the climate in Mongolia, effects of climate change are difficult to separate from variability in a short term. Modifications of ecological conditions will trigger changes of habitats and biodiversity. However the direct impacts due to climate change may be considered as a natural evolution of ecological conditions and may not necessarily require remedial measures. Indirect changes, though, such as adaptations of human practices due to modification of climate should be evaluated as they are more controllable.

2.5. Clusters of river basins

For the assessment of water quality and ecological conditions the river basins of Mongolia are grouped in six clusters of similar climatic conditions, geographical characteristics, basin type (surface water, groundwater or combined) and land cover as presented in Figure 2 and Table 4.

This approach allows (with the necessary caution) to extrapolate results of limited studies in one river basin to other river basins within the same cluster. Organizing the report in this way serves to limit repetition and remain focused on the main issues and it helps to better understand the regional issues related to water quality and ecology. However, the river basin remains the unit of management – also on water quality and ecological issues.

Figure 2. The six clusters of river basins

Table 4. Cluster of basins

Cluster name	River basin name	Basin type	Outlet
Western basins	Khyargas Nuur-Zavkhan	Surface water	Central Asian Basin
	Bulgan		
	Khar Nuur-Khovd		
	Uvs Nuur-Tes		
Western Gobi basins	Altain Uvur Govi	Groundwater	
	Huisiin Govi-Tsetseg Nuur	Combined	
	Uyench-Bodonch		
Eastern Gobi basins	Menengiin tal	Groundwater	Pacific Basin
	Umard goviin Guveet-Khalkhiin Dundad Tal		Central Asian Basin
	Galba-Uush-Doloodiin Govi		
Valley of Gobi Lakes	Ongi	Combined	
	Taats		
	Tui		
	Baidrag-Buuntsagaan		

Cluster name	River basin name	Basin type	Outlet
Eastern basins	Onon	Surface water	Pacific Basin
	Ulz		
	Kherlen		
	Khalkh gol	Combined	
Arctic basins	Selenge murun	Surface water	Arctic basin
	Khuvsgul-Eg		
	Shishkhid		
	Delgermuron-Bugsui		
	Ider river		
	Chuluut		
	Khanui		
	Orkhon-Tamir		
	Tuul		
	Kharaa-Shariin gol		
	Eroo-Khuder-Minj		

2.6. Summary of the pressures for each cluster of basins and at national level

For each cluster of basins, after a description of surface water quality, groundwater quality and current ecological conditions, impacts of human activities are described using eight different categories: domestic activities, crop cultivation and irrigation, livestock herding, industries and mines, forest management, tourism, fishing and construction of dams. At the end of each cluster description in a table the main pressures from human activities having an impact on water quality or ecosystems are summarized. This table also includes the impacts caused by climate change.

Each human activity can be the source of different pressures. For instance livestock herding activities can cause wildlife disturbance, can cause bacteriological contamination in water bodies, or can impact riparian vegetation through grazing.

Some human activities are widespread and their impacts are noticable in many basins. These pressures, which often occur on a national level, are described in Table 26 with guidelines for remediational measures. Maps of the locations of the known pressures are shown in section 9.2.

It should be noticed that those maps just refer to locations where issues have been assessed by recent studies or confirmed by available data. Current issues can occur on other locations but data or studies might have not been available to assess the degree of impact on water quality, ecosystems or ecological services.

3. Western basins cluster

3.1. The river basins

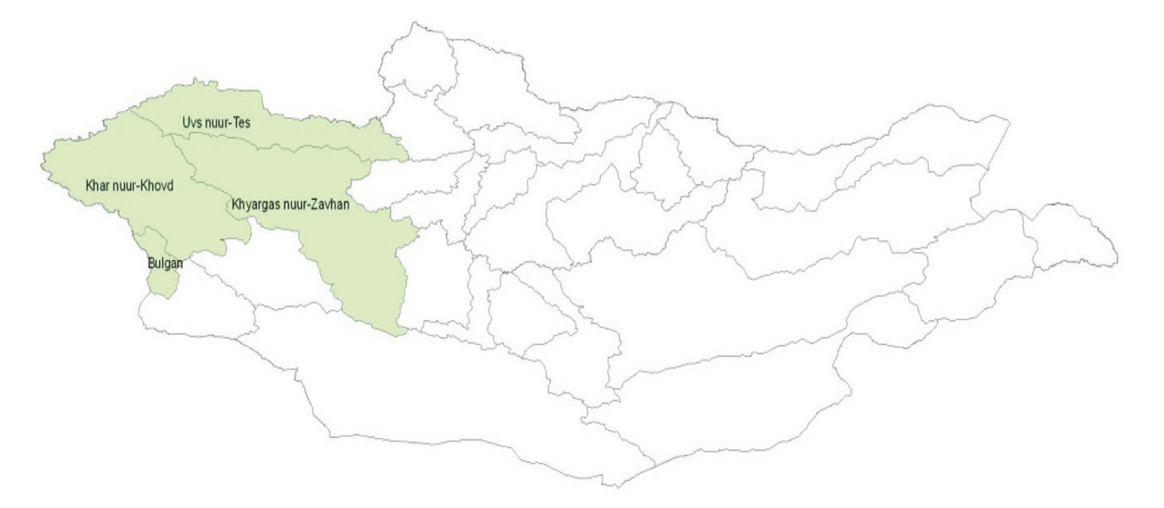

Figure 3. River basins of the Western basins cluster

3.1.1. Geography

The Western basins cluster comprises the northern Altai Mountains and the Valley of the Great Lakes. The Valley of the Great Lakes is bounded by the Altai Mountains to the west, the Khangai Mountains to the east, and the Gobi Desert to the south. The Valley of the Great Lakes was formed during the late Tertiary. The Great Lakes region is part of the endorheic Central Asian Basin and includes several smaller closed drainage basins with lakes ranging from fresh to hypersaline. Many of the large terminal basins in the valley are believed to be the remnants of large Tertiary or Quaternary paleo-lakes.

The Valley of the Great Lakes is an aggregation of several closed inland depressions, or endorheic basins: surface runoff that is generated within the basin remains inside its boundaries. Precipitation, in the form of rain or snow, may fall on a mountain top; be stored in glaciers or soils; evaporate on its downstream travel through river channels, lakes or open wetlands; evapo-transpirate through wetland or riparian flora; or eventually recharge one of the landlocked lakes, such as Uvs Nuur or Khyargas Nuur.

The average altitude is relatively high at around 2000 m above sea level, ranging from the lowest point of 760 m at Uvs Nuur to over 4000 m in the Mongolian Altai.

Climate in the Western basins cluster is extreme continental, coldest in January reaching above -40˚C, and hot summer with maximums reaching up to 40˚C. The Uvs Nuur basin is also known to be the coldest place in Mongolia. There is a strong gradient of annual precipitation in the region, as well as several ecosystem boundaries, making the region highly responsive to changes in effective moisture. Most of the area experiences annual temperature fluctuations in the range of -40˚ to +40˚ C, with the minimum and maximum temperatures recorded in the country separated by nearly 100˚ C. Winters are cold and dry, Most precipitation in the region falls in summer, the result of local storm activity.

The main water resources are located in the mountain region. About 60% of the annual runoff of the Khovd river basin is generated by glacier and snow melting on the Altai Mountains.

3.1.2. Land cover

Pasture land occupies 84% of the total area of the Western basins cluster, which is the same as the national average. Forest cover is not really significant except in the Uvs Nuur-Tes basin, where scattered forest cover occupies nearly 10% of the area, mainly in the east mountainous part of the basin (Figure 4 and Table 5).

Source: National Atlas - 2009

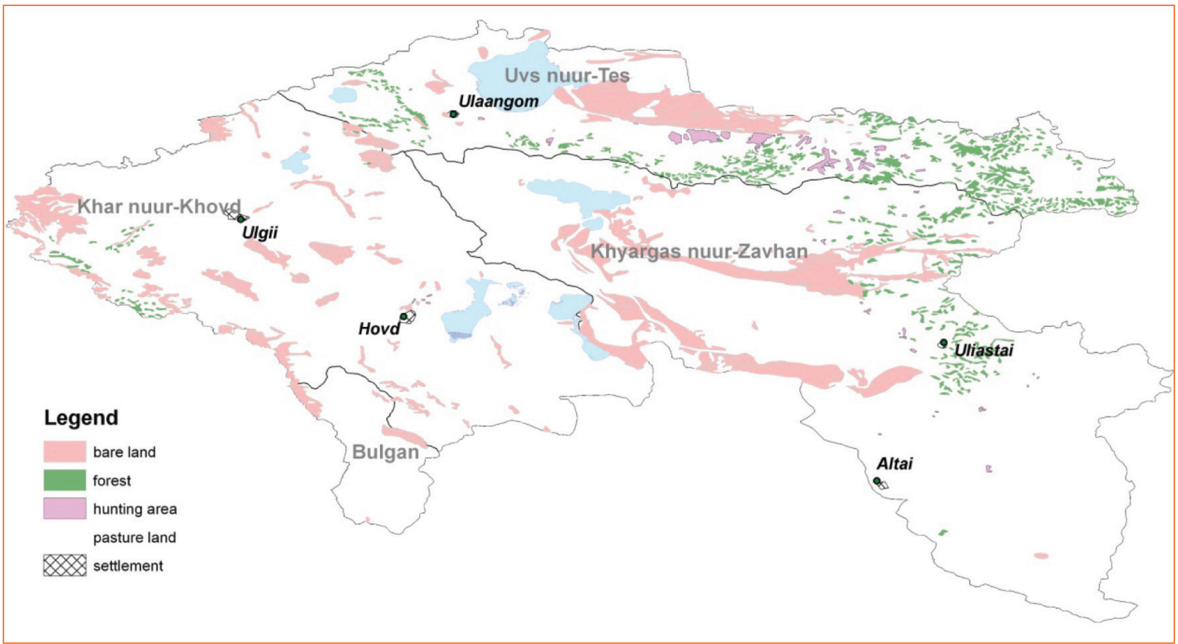

Figure 4. Land cover of the Western basins cluster

Table 5. Land cover of the Western basins cluster

	land cover (% of basin)						
River basin	abandoned land	bare land	crop land	forest	pasture land	settlement	water
Uvs Nuur-Tes	1.7	10.3	0.4	9.4	70.7	0.4	7.1
Khar Nuur-Khovd	0.0	9.3	-	0.5	86.2	0.3	3.7
Khyargas Nuur-Zavkhan	0.1	8.7	-	1.9	87.5	0.1	1.7
Bulgan	-	6.6	-	-	93.4	-	0.1

Source: National Atlas - 2009

Land degradation, especially loss of vegetation cover has been observed in this region. Locally, loss of vegetation cover and pasture land has been observed during the last decades. Sedimentation rate has considerably increased in the lake as well, indicating that soil erosion is intensifying in the region. Zemmrich [4] established that degradation factors are multiple; land degradation in desert steppe is mainly driven by soil moisture deficiency in desert steppe, while grazing leads to substantial changes of vegetation in mountainous areas.

Increasing grazing pressure and concentration of livestock in certain areas close to surface water are factors explaining this degradation of land cover.

3.1.3. The river network

The Western basins cluster comprises three main rivers and their basins: the Tes (Uvs Nuur basin), the Khovd (Khar Nuur Khovd basin), and the Zavkhan (Khyargas Nuur basin) and the smaller Bulgan river basin, which is not connected to the former ones, and drains in a north to south direction through the Bulgan River, to China.

Table 6. Characteristics of the basins in the Western basins cluster

River Basin	Basin area, *km²*	Main river length, *km*	Mean slope, *‰*	Mean basin elevation, *m*	Total length of river network, *km*	River network density, *km/km²*
Khyargas Nuur-Zavkhan	68,737.7	808	0.0027	2040	25,203.9	0.36
Khar Nuur-Khovd	58,514	596	0.0039	2700	35799	0.612
Uvs Nuur-Tes	21,027	426	0.0029	1682	5,083.64	0.24
Bulgan	9,853.3	268	0.001	2180	6,713.39	0.68

Source: IMH

The Tes River is the major water source of Uvs Nuur, contributing some 57% of its total inflow. The river originates in the marshlands of the Bulnai Mountains and has a total length of more than 420km and a watershed area of approximately 21,000 km^2.

The Khovd River is the largest river in this cluster of basins in terms of average annual discharge. The river originates at Mongolian Altai, with melted ice and snow as its principal water sources. Main tributaries are Tsagaan, Sogoot, Sagsai, and Buyant River. The main lakes that discharge their excess waters into the Khovd River are Dayan, Tolbo, and Achit. The waters of the Khovd River finally flow through lakes Khar-Us and Dalai and the connecting Chonokharaikh River into Khar Nuur. From there, the flow is divided and drains partly into the closed Dorgon Nuur, and partly through the Teeliin Hooloi River into the Zavkhan River. The annual mean discharge of the Khovd River is 58 m^3/s in its upper reach (at Ulgii), 63 m^3/s in the middle reach (at Bayannuur), and 90 m^3/s at its outflow into Khar-Us Nuur (at Myangad).

The Zavkhan River originates at the confluence of the Buyant and Shar-Us Rivers in the Khangai Mountains, and is later joined by the Shurgiin River. The Zavkhan is 808 km long and has a total watershed area of 68738m^2 The marshes at the foot of the Khangai Mountains (upstream of the confluence with the Shurgiin River) have a strong regulating effect on the flow regime. The Zavkhan crosses the sand dunes of the Ikh Mongol Els, which stretch along the river valley between the lower slopes of the Khangai Mountains and Khyargas Nuur. Considerable amounts of the river flow are lost through percolation into the sand dunes. This, however, has a positive effect on the local climate by recharging the soil water content and protecting the area from extreme droughts and desertification. The Zavkhan River finally discharges into Airag Nuur and the connected Khyargas Nuur. The annual mean discharge of the upper Zavkhan River is 12m^3/s (at Guulin) and reaches 28 m^3/s at the outflow into Airag Nuur.

The most specific hydrological feature of the Western Basins is its large number of landlocked lakes. The lakes of the Western Basins represent about 20% in number, and nearly 60% of the total area of all Mongolian lakes. There are four large lakes with individual surface areas of more than 500 km^2: Uvs Nuur, which is the largest lake in Mongolia by surface area, Khyargas Nuur, Khar-Us Nuur, and Khar Nuur. With some 116 km^3 of total volume, these four lakes together hold about 23% of the water stored in all Mongolian lakes.

In addition there are numerous large and small permanent and ephemeral ponds, playa lakes, floodplain lakes, and dune-blocked lakes. There are 123 lakes with a total area of 5640 km^2 in Uvs aimag, 84 lakes (2835 km^2) in Khovd aimag, 264 lakes (522 km^2) in Bayan-Ulgii aimag, and 96 lakes (553 km^2) in Zavkhan aimag. These lakes play an important role for a wide variety of species, biological cycles, and human uses. This unique pattern highly depends on water levels and connectivity between lakes, rivers, and groundwater.

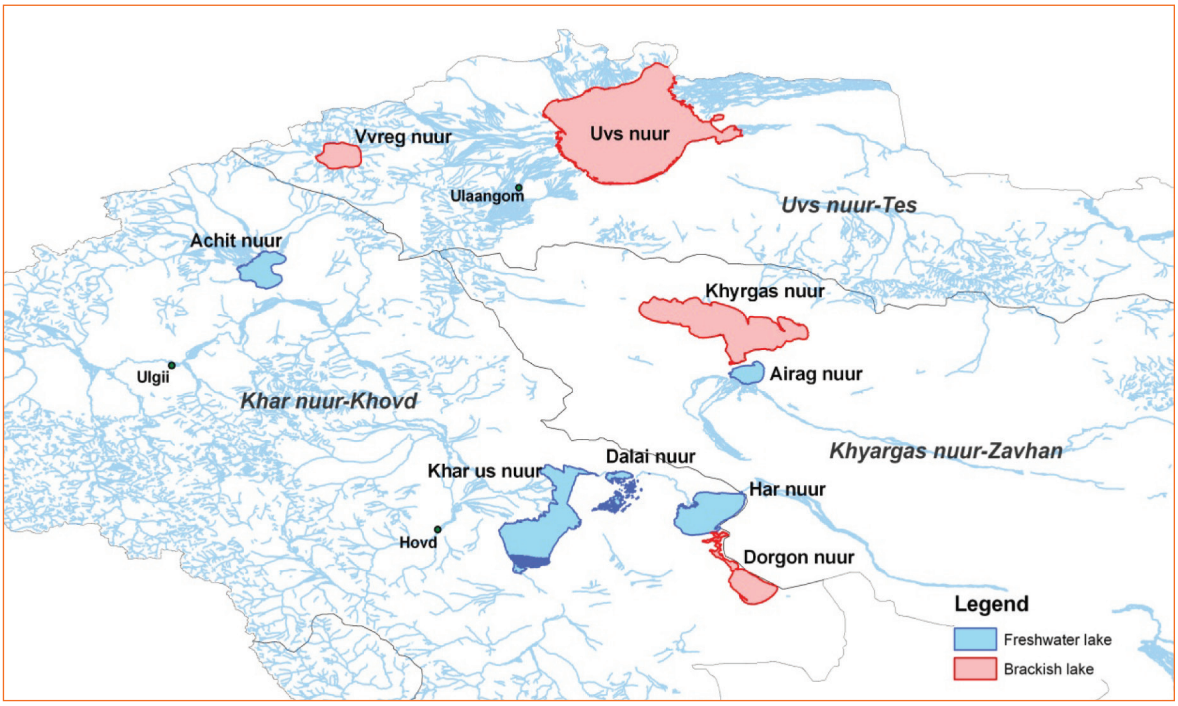

Figure 5. Location of the main lakes in the Western basins cluster

Although this cluster of basins has similar soil characteristics and common water composition in rivers, many lakes are brackish as they do not have any outflow. Evaporation leads to a gradual increase of salt concentration in these lakes, and eventually to ecosystems that differ from the freshwater lakes upstream. The Uvs Nuur, Khyargas Nuur and Dorgon Nuur are the well known examples of brackish lakes in the Western Basins, there are hundreds of other smaller brackish lakes in the area.

Har Nuur and Dorgon Nuur are connected with a system of channels. Gilbert [5] reported in 2009 that several channels connecting these two lakes disappeared. Locals reported these channels to be temporarily dry. Factors triggering the decrease of the water levels have not been assessed clearly; climate variability and impacts of the Durgun dam upstream could be the main factors. Small lakes connected south to Dorgon Nuur have been reported to dry up as well. If water levels continue to fall Dorgon Nuur could eventually become disconnected from the rest of the watershed as the Har Nuur is by far the biggest contributor to Dorgon Nuur. Har Nuur would then have no outflow and mineralization would increase dramatically, impacting ecology and water availability for livestock.

3.2. Surface water quality

3.2.1. Monitoring Network

Monitoring of chemical composition and quality of water of rivers and lakes in Khovd and Buyant river basins has been taking place since 1977. The National Agency for *Hydrometeorology* and *Environmental monitoring* opened in 2005 and there are 9 monitoring points on a total of five rivers and one lake in the basins. Several short studies have been carried out on the Uvs Nuur-Tes, the Khar Nuur-Khovd and the Khyargas Nuur-Zavkhan basins to assess impact of human activities, but very few surface water quality data are available on the Bulgan basin.

3.2.2. Trends in surface water quality

The ionic distribution is typical for pristine rivers and reflects the good condition of the rivers of the Western Basins [6] Calcium and bicarbonates are the dominant ions in all of the rivers of the Western basins cluster. The overall concentration of ions in rivers of the Western basins cluster is relatively low, ranging from 60 to 170 mg/l, except for the Tes River which contains up to 450 mg/l.

Mineralization is logically much higher in closed lakes like Durgun (4240 mg/l), Uvs Nuur (12600 mg/l) and Tolbo Nuur (839 mg/l).

Minerals in rivers and lakes in Khar-Nuur Khovd River basin are mainly composed of calcium (Ca2+) for cations and hydrocarbonate (HCO_3^-) for anions. The cation ratio is Ca2+ > Na+K > Mg^{2+} and the anion ratio is HCO_3^- > SO_4^{2-} > Cl. These ratios correspond to a natural water composition. Long term monitoring (1977-2009) showed no changes in ion concentration in the surveyed rivers.

No long data series from monitoring are available on fresh lakes mineralization; Shinneman [7] observed that sedimentation rate increased in lakes since the 1990s, especially nearby urban areas. Concentration of minerals in lakes can be expected to have increased as well in freshwater lakes. Deterioration of land cover will increase erosion, thus transfer soil particles in the rivers and could lead to a higher mineralization of the surface water.

Monitoring data are available on nutrients, specifically on nitrite, nitrate, ammonium, and phosphorus concentration. In most cases, water pollution in the rivers and lakes of the Western basins cluster are below the limits defined by the Surface Water Standards of Mongolia.

Locally, monitoring in Khovd and Buyant rivers showed that levels of pollutants, especially ammonium, exceeded the permissible concentrations. In addition, mineralization, nitrogen, and oxidisable organic substance contents in water exceeded the respective permissible limits, especially near towns and human settlements. For instance increased ammonium concentrations are found in the rivers that drain into Khar-Us Nuur, ranging from a minimum of 0.01 to more than 4.2 mg/l. Excessive concentrations of nitrite in surface water are another issue. Concentrations of nitrite exceeding the permissible amount have been recorded in Khovd-Myangad, Buyant-Khovd, and Shurag rivers and southern bank of Khar Us Nuur (from 2 to 35 times the permissible concentrations).

The origin of nitrite in the basins has not been established clearly; it is for instance yet unclear why high nitrite and ammonium concentration are not combined with high levels of nitrate in the surface water, whereas concentrations of nitrate are usually higher than nitrite and ammonium. Concentration of livestock can increase nitrite concentration in soils and rivers as they convert nitrate to nitrite and ammonium during the digestion process, but can not explain why nitrite contents are higher than nitrate.

The nitrite concentrations in surface water do not reach concentrations toxic to livestock leading to a loss of productivity. Further studies should determine if livestock is the only source of nitrite.. Since the central planning of migrations of livestock has been abolished, de-regulation has considerably altered usual cycles of land use, with herders increasing herd sizes. Livestock concentration dramatically increased in smaller areas near towns and villages and close to water points [8];[9].

Lakes accumulate pollution from upstream in their sedimen-ts, which are quite suitable to serve as an indicator for changes of the water quality in the basins.

Shinneman et al. [7] reconstructed the nutrient status of lakes in the Western basins cluster over the past 120 years and revealed that the nutrient content, mainly phosphorus, increased dramatically. Analysis of lake sediments indicate that recent trends in nutrient concentrations are outside the normal range of variability; for example total phosphorus values averaged 0.18 mg/l (ranging from 0.007 mg/l to over 2 mg/l), well above the nutrient concentration standards for most parts of the world.

Several factors could explain this recent increase in nutrient concentration. Transfer of phosphorus from lake sediments to water is expected increase due to a combination of changes in the stratification process of lacustrine water caused by climatic conditions, biotic uptake of phosphorus, and other factors [7]. However no major temperature fluctuation occurred in the early 1990s when most lakes showed the pronounced shift in sediment properties. Additionally, the rapid changes in sediment composition in the two more ‘urban’ lakes (Baga and Takhilt) coincide with the rapid shifts in herd size during the dzud years, with phosphorus concentrations varying accordingly to the livestock number suggesting that changes in water quality can be linked to the increasing grazing intensity, especially near population centers. Moreover, all lakes within 20 km of a town were eutrophic to hyper-eutrophic while lakes farther from settlements typically had lower total phosphorus values. Observations point to changes in human and animal impact on the landscape, rather than climate change as the main driver for recent eutrophication.

Many of the lakes in the Western basins cluster are relatively shallow and therefore very sensitive to (even minor) perturbations, like an increase of nutrient concentration. Changes in chemical composition and biological cycles as a result of eutrophication or loss of habitats in these lakes can occur rapidly and are difficult to reverse.

Increasing concentrations of bacillus causing stomach diseases have been reported in the lower parts of Khovd basin [10]. Concentration of livestock around water bodies is likely to be the source of this bacterial pollution. This is a factor of impacts on human health and livestock production downstream.

3.3. Groundwater quality

3.3.1. Monitoring Network

Data have been collected in shallow and deep aquifers from 1971 until 1990. Data for the respective aimags are available for the major ions, pH, and sometimes analyses have been done on nitrogen-based molecules. No studies on heavy metal concentration are available, but as mining pressure in these basins is low, chances of heavy metals contamination are small. Data on bacteriological analysis are scarce.

3.3.2. Trends in groundwater quality

Mineralization of ground water is generally high in shallow and deep wells aquifer, sometimes exceeding the standard for drinking water (1000 mg/l), especially in the Uvs, Khyargas and Bulgan river basins.

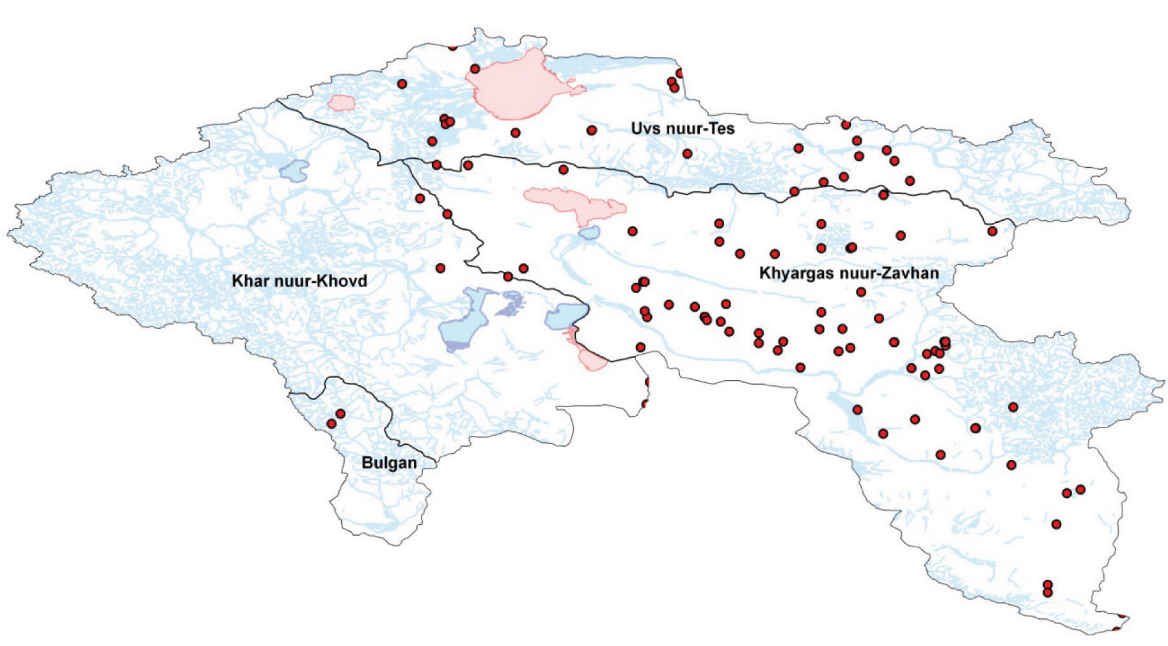

Figure 6. Location of the wells where mineralization exceeds 1000 mg/l in the Western basins cluster

HCO_3^- is usually the major ion, but sometimes sulfate is dominant. Especially in the Khyargas river basin sulphate often reaches values above the Drinking Water Standards (500 mg/l). Sulfate is definitely not due to human activities; it derives from the dissolution of soluble SO_4^{2-} and S minerals in sedimentary rocks. High concentration of sulfate can trigger sanitary issues, such as laxative effects generating dehydration and can cause loss of livestock productivity. Sulfate can not be removed by the use of filters. Reverse osmosis and distillation are the most effective treatment to remove sulfate but is very costly and not possible to implement on a large scale.

Figure 7. Location of the wells where Sulfate exceeds 400 mg/l in the Western basins cluster

Values of pH are acceptable for human use almost everywhere in the basins, with a very few instances with pH values slightly exceeding 8 in shallow aquifers.

Nitrite concentrations exceeding the standards for drinking water (0.02 mg/l) are widely reported in all the basins for shallow and deep wells, with the exception of Uvs Nuur basin. This is an issue for food security as nitrite can trigger health problems, including shortness of breath and blue baby syndrome. Livestock could be the source of these concentrations of nitrite, but since deep groundwater appears affected as well, the origin is more likely to be natural. However concentrations of nitrates are sometimes lower than the concentration of nitrite for the same samples, which is not in accordance with the ratio generally observed regarding nitrite and nitrates. This should trigger some reservations about the reliability of some of the data concerning these compounds. Nevertheless, since recent studies report a high content of nitrite at some locations in Khar Nuur Khovd river basin, sanitary control and protection of wells from livestock should be reinforced in these basins.

No cases of bacterial contamination have been reported, but very little information is available. As livestock tends to concentrate around the remaining wells, the risk of bacterial contamination increases. Better maintenance of shallow wells protection, accompanied by raising public awareness would limit the threats to human health and avoid treatment costs.

3.4. Ecological conditions

The basins support a great variety of ecosystems; high mountain tundra, glaciers, snow patches, forest and mountain meadows, forest steppe, mountain steppe, rocks, dry steppe, and desert ecosystems are found within the basins.

The rivers originate in the high mountain and are fed by glaciers whereas in their lower parts, conditions are dry and rainfall just contributes a few % to the total runoff. Precipitation is concentrated in summer, mostly in the form of rainstorms, resulting in quite some variation in the rivers' run-off. Lateral connectivity of the river systems varies through the year. From June to August temperatures are relatively high in the downstream part of the basins, so algae and macrobiotic productivity are not limited by temperature. But as mineralization is naturally low, biological production is constrained.

According to the specific characteristics of habitat, the basins support regional endemic fauna (e.g. fish, reptiles, and mammals) that have had good ecological adaptation capacities during long term historical evolution.

3.4.1. Ecological monitoring

Few long term data series have been found on the Western basins. Presently, due to the ecological interest in the region, surveys are carried out on hydrology, water quality, ecology and the impacts of human use and climate change. The absence of long term monitoring data makes hard to establish trends for water quality and environmental conditions. However, lake sediments may provide good insight, as they store long term information, and lakes are widespread in the region.

The WWF [10] observed a lack of research and monitoring by national parks' staff in Khovd aimag. Monitoring results were not even reported by rangers in `Khangai Ecoregion Ranger Assessment` [11]. Schuerholz reported that the environmental monitoring to be implemented by every Protected Area Ranger in Mongolia is limited to completing the standardized "monitoring forms" on which to record information on special events related to climate, weather and seasons: by recording the dates of the first snow- melt or ice breakup in rivers and lakes, seasonal wildlife activities, dates of flooding; fires, insect epidemics, etc.

Apart from completing the "monitoring" forms, rangers are required to make bi-monthly "wildlife" observations from "fixed points" to be selected by the Ranger at his own discretion. "Wildlife" however, is not defined, and the selection of species to be recorded is left to the discretion of the Ranger. Rangers who were quizzed on the term refer to "wildlife" as larger mammals and birds, hence in their perception it does not include flora or fish for example. In view of the apparent limited and varying degree of taxonomic knowledge among rangers, the information provided through the bi-monthly observations is of questionable value.

According to this report, the information collected by the Rangers appeared to bear little relevance to protection and management. Diffusion of the information itself may be a problem as hand-written recordings are submitted by the rangers once a year to the Chief Ranger of a protected area to be evaluated and forwarded to the Ministry of Nature and Environment.

As the network of protected areas covers sites with a specific ecological interest including many water bodies in this region, improvement of training for Rangers, better job descriptions, and reinforcement of their cooperation with scientists could considerably improve the efficiency of the monitoring network in protected areas.

3.4.2. Aquatic ecology

Biological indicators suggest that generally the aquatic environments in the Western basins cluster are presently in good condition, especially the upstream parts of the rivers.

In several river and lake surveys within the region, 32-59 macroinvertebrate species were collected, out of which 24-32% were stoneflies, 26-29% mayflies, and 23-37% caddisflies [12]. These species are highly dependent on a high level of dissolved oxygen concentration for the development of the nymphs; their presence suggests a good water quality and suitable habitats. However, the intensified land use since these surveys were done, resulting in increases of erosion rate and loss of riparian vegetation, are likely to have lead to a degradation of habitats.

The self-purification capacity of the rivers is a process that depends on multiple factors such as river channel type, occurrence of inundation, flow, presence of riparian vegetation, etc. and is therefore difficult quantify. However, the loss of wetland area, the degradation of riparian vegetation, and the reduction of flow unquestionably will lead to a reduction of self-purification capacity.

Aquatic species are adapted to fluctuating water levels and seasonal desiccation of lakes and wetlands in the Western basins cluster and thus have developed remarkable abilities to survive under these conditions. For example, some fish species retreat to permanent rivers or lakes during dry periods and then move into seasonally flooded wetlands during the wet season. This means that unhindered migration of fish and other aquatic species between rivers and lakes is vital. Any perturbation of river and lake connectivity or of the conditions in only one of the connected habitats may have consequences for populations throughout the basin.

Ten fish species have been recorded in the rivers and lakes of the Western basins cluster, and many of them are endemic to the region such as the Mongolian Grayling, the Altai Osman *(Oreoleuciscus potanini)*, the Dwarf Altai Osman (*Oreoleuciscus humilis*), the Carnivorous Altai Osman (*Oreoleuciscus sp.*) and the Spotted Thicklip Loach (*Nemachilus strauchi*). Generally, most of the lakes with fresh water show a higher diversity of fish species than the brackish or saline lakes. For example, the freshwater lakes Khar-Us and Khar each contain four fish species (including lake forms of the Altai Osman and Mongolian Grayling), whereas only the Altai Osman is found in the saline Durgun Nuur and Khyargas Nuur.

According to IUCN criteria, the Dzungarian Dace (*Leuciscus dzungaricus* or 'Jungariin sugas' in Mongolian) is the only endangered fish species that occurs in this cluster of basins. This fish species has been reported to live only in the lower part of Bulgan River (Bulgan river basin). No data are available on habitats and ecology of this species. Illegal commercial fishing has been reported as the major threat. The Lake Osman or Bigmouth Osman (*Oreoleuciscus angusticephalus* or 'nohoi sugas' in Mongolian) and the Small Osman (*Oreoleuciscus humilis or* 'dabjaa sugas' in Mongolian) categorized as regionally threatened.

Three species of Ciscos (*Coregonus autumnalis autumnalis*, *C. peled* and *C. sardinella*) have been introduced in the lakes between 1960 and 1985. Apparently *C. sardinella* did not establish. Ciscos are not reported as a valuable fish in the region and no studies are available that assessed the impact of these introductions on the other populations of fish.

Fishing and fish farming sectors used to be undeveloped in the Western basins cluster. However, in recent years, recreational and commercial fishing appear to have increased; Gilbert [5] reported the use of large fishnets in Khar Us Nuur. Additionally, a recent study showed a 19% decrease in fish stock in Khar Us Nuur. So far no conservation measures aimed at this species have been established, but since data on population, spawning period or location are not available, an investigation of other potential threats affecting the population should to be carried out before designing protective measures.

The large quantities of fish stocks species in the lakes are mainly due to their high adaptability to the variety of conditions and food sources. Osmans can live in rivers with a wide range of dissolved oxygen concentrations and conductivity, and are well adapted to the diversity of conditions in the different water bodies of the Western basins cluster.

Illegal fishing, overfishing and habitat loss and degradation are the main threats. In the Khar Nuur-Khovd basin, the construction of Durgun dam is likely to restrict Osmans' spawning migration, although these species are not known to migrate over long distances.

A reduction of the Osman population represents an issue as these freshwater fish are used for commercial and recreational fishing, bringing valuable resources to the local economy. It is important to notice that a decrease of the Osman population would not represent a major gain on biomass from other fish population, as they are not as adapted to the ecological conditions. Hence the protection of the Osman population and habitats is necessary to ensure its continued existence and its sustainable use.

Conservation of this species is incorporated in Mongolian laws. The Mongolian Law on Hunting prohibits the catching of all Osman species from April 15th and August 1st [13]. These dates seems coherent with Osmans' spawning period, as Dulmaa reported the spawning season extends from late June to August for the dwarf osman and from 1-2 weeks after the disappearance of ice until May for the bigmouth osman. However, enforcing this ban has been reported to be difficult [10].

The Mongolian Grayling is reportedly the second major commercial species. Its biological cycle is different than that of Osmans, as it mainly lives in mountain rivers and starts to migrate in autumn to the deep water layers of lakes during the winter season. Little is known about its migration habits. However, other types of Graylings are reported to migrate hundreds of kilometers. Hence, as opposed to Osmans, which have a much shorter migratory range, obstacles to migration are much more likely to impact Mongolian Grayling`s biological cycles and reduce its population.

3.4.2. Terrestrial ecology

The Western Basins are home of important nesting and migratory sites. There are more than 20 distinct Important Bird Areas in the region and most of them are related to lakes or wetlands areas. The lakes and wetlands provide important breeding ground and a migration stopover for about 369 bird species, of which 10 are endangered, 21 are nationally threatened, and 41 are rare and listed in the Mongolian Red Book [14].

The Bulgan River is an important stopover site for various migratory passerines, waterbirds and shorebirds. Generally threatened species that regularly migrate through the site are Swan Goose (endangered), Eastern Imperial Eagle and Lesser Kestrel (both vulnerable species).

At and on the Uvs Nuur, more than 220 bird species are counted. Numerous rare and threatened species are among them: Black Stork, Osprey, White-tailed Eagle, Whooper Swan and Black-headed Gull.

Airag Nuur is considered as an exceptionally important breeding and resting site for a great variety of waterbirds (ten species of waterbirds belonging to the Mongolian red list of birds are known to settle in Ayrag Nuur). Moreover, it is the last place in Mongolia where the Dalmatian Pelican regularly comes to breed. Dramatic decrease of Dalmatian Pelican population in the region seems not directly linked to a degradation of its habitats, as a recent study suggested that over 90% of the pelican population drop was due to hunting pressure [15]. Some actions have been taken recently to ensure the sustainability of Dalmatian Pelican in the Khar Us Nuur and Airag Nuur area, by installing artificial nesting platforms. However these nesting platforms are more used by rapaces than by Dalmatian Pelican.

Although many of the wetlands are locally or nationally protected and should not suffer from habitat degradation, the main factors of habitat degradation are the overgrazing pressure and bulrush cuttings around these wetlands. Decrease of fish population in the lakes, reducing the food source of migratory and non-migratory species, may as well be a factor affecting the bird lifecycle. A better implementation of existing environmental policies inside the protected areas needs to be enforced to preserve habitats.

One species of amphibians, the Pewzow's toad or Central Asian green toad ('nogoon bakh' or 'tovaziin bakh' in Mongolian) is considered as `vulnerable` according to The Mongolian Red list of amphibians [16]. This species has an estimated extent of occurrence of around 16,200 km^2 and is found in fewer than 10 locations (Bulgan River, springs and rivers in mountainous areas, and a group of four separated oases in Dzungarian Govi Desert). The species is experiencing habitat degradation due to pollution from mining, habitat damage from livestock trampling springs and the establishment of human settlements near oases, and there is no significant immigration from adjacent countries.

The muskrat (*Ondatra zibethica*) was introduced to Khar Us and Har Us Lakes for fur production in 1967. The species has spread widely and successfully invaded the whole lake and wetland ecosystem. Muskrats feed from reed beds and cause damage by eating reed shoots and roots which causes a deterioration and fragmentation of the wetland vegetation. Impacts of muskrat on vegetation have been reported since 1999. This causes a loss of stabilization of the lake and islands shores and eventually leads to a significant loss of habitats for water birds, amphibians, and spawning sites for fish. According to park rangers and herders, several large islands have disappeared in the last two decades because of mechanical deterioration. Local people complained about the impact of muskrats in the area. There are no data available on muskrat population and no monitoring of the impacts caused by the muskrat has been carried out yet.

An uncontrolled increase of muskrat population would lead to the loss of reed beds areas that would ultimately reduce essential biological habitats and eventually fish stocks which are a valuable resource for local people. Measures need to be taken to limit its population as muskrat fur is not an important commercial activity anymore. These measures are best implemented as part of the national parks and protected areas management plans.

3.4.4. Zones with a specific ecological interest

The Western Basins cover an important portion of protected areas and sites, with almost 19% of the area having a local (6.5%) or national (12.4%) protection status (Figure 8). Uvs Nuur and Ayrag Nuur sites have a 'strictly protected area' status, whereas Khar us Nuur, Har us Nuur and Dorgon Nuur are within the `Khar us Nuur natural conservation park`. The lower part of the Bulgan basin, where the last Mongolian population of Dunzarian Dace has been observed, has a natural reserve status, though it is not known whether this area covers the whole distribution area of the Dunzarian Dace.

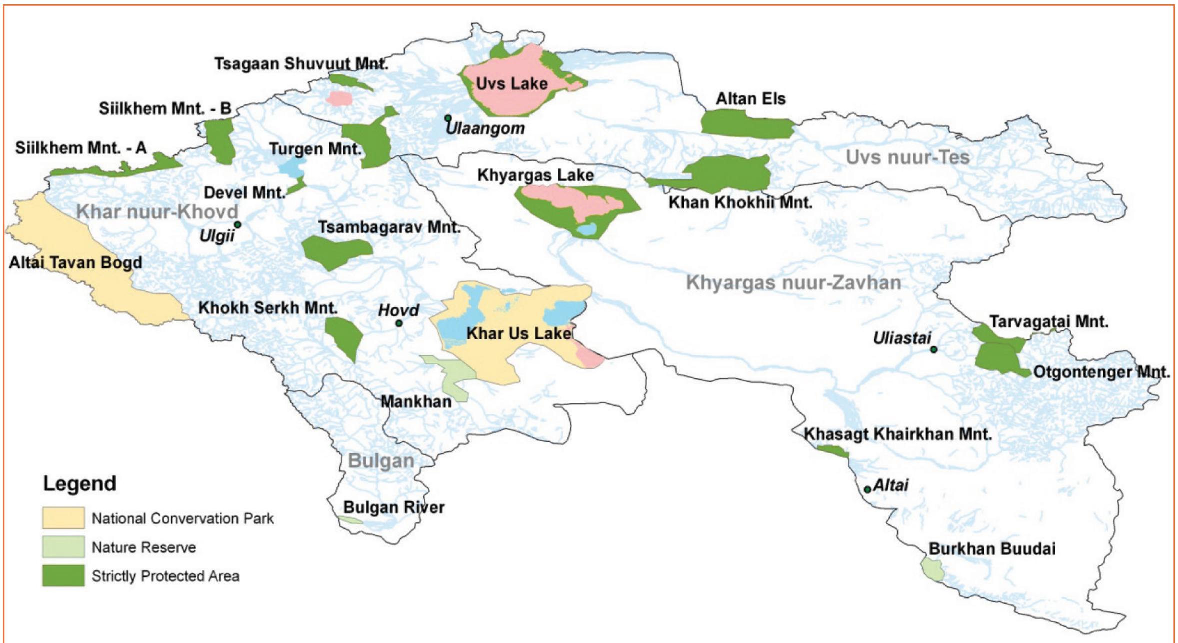

Figure 8. Location of nationally protected areas in the Western basins cluster

Additionally, four wetland areas are identified as RAMSAR sites in the Western basins cluster (Table 7 and Figure 9).

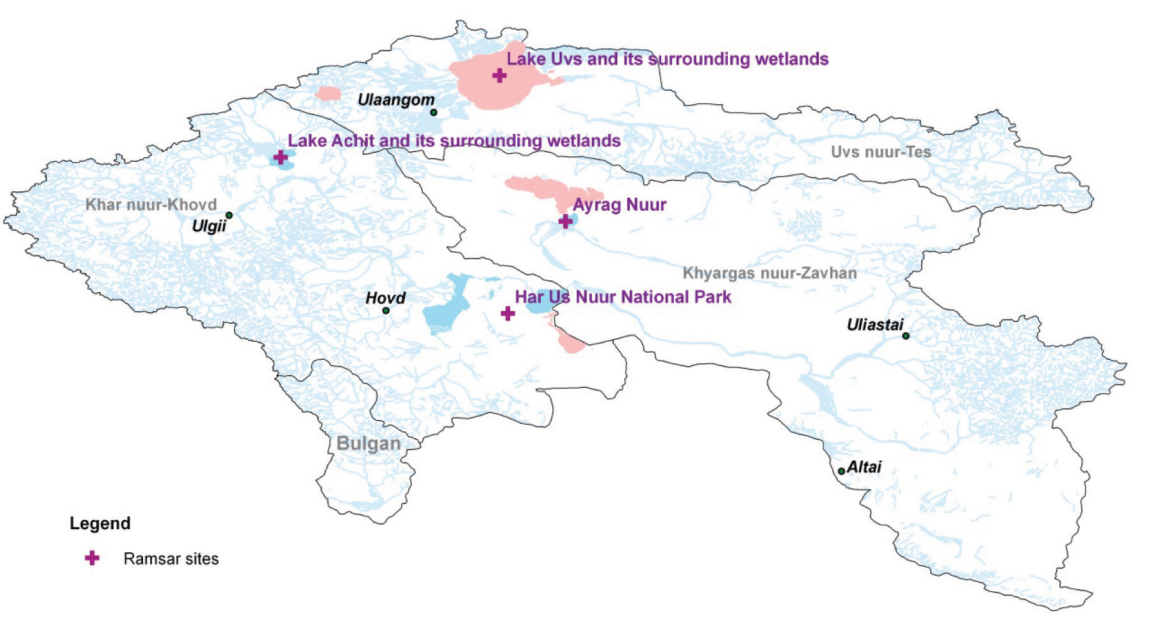

Figure 9. Location of RAMSAR sites in the Western basins cluster

Three of these RAMSAR sites are totally or partly located inside a national park (Har Us Nuur site) or a strictly protected area (Uvs Nuur and surrounding wetlands, Ayrag Nuur).

Table 7. RAMSAR sites in the Western basins

River basin	Ramsar site name	Aimag	Area, *km²*	Ramsar code
Uvs Nuur-Tes	Lake Uvs and its surrounding wetlands	Uvs	5,850	MN010
Khar Nuur-Khovd	Har Us Nuur National Park	Hovd	3,213.6	MN005
Khar Nuur-Khovd	Lake Achit and its surrounding wetlands	Bayan-Ulgii, Uvs	737.6	MN007
Khyargas Nuur-Zavkhan	Ayrag Nuur	Hovd	450	MN006

Only the southern part of Achit Nuur has a national protected status (Devel strictly protected area), whereas the northern part of the lake has recently been designated as a local protected area. Use of trees and bushes for firewood, and hunting for beavers and reed boars have been reported [17]. An increase of the Devel strictly protected area around Achit Nuur has been proposed but this didn't receive sufficient support. The northwest shores of this lake are populated, therefore strict protection measures and bans on human activities such as pasture uses or other land use would be very difficult to implement. Public awareness and appropriate measures taking into account human needs would then be better tools for the protection of the Achit Nuur habitats. Special attention should focus on its northwest shore is composed of marshy areas with a rare associated flora and important areas for birds.

The designation of protected areas does not necessarily guarantee a full protection of the sites, as wood and bulrush cutting, as well as illegal fishing and poaching are still being reported in these zones [12]. According to this study, Uvs Nuur strictly protected area supports various human pressures, as well as Khar us Nuur national park.

Other national protected areas in the cluster of basins were not assessed, but it can safely be assume that they suffer from similar pressures and threats as environmental conditions and practices are the same across the region. Patrolling and monitoring, public awareness and restoration activities are usually insufficient, as was reported In Khar Us Nuur park [18].

Protected areas cover sites with specific ecological interests and cover mainly water bodies in this region. Improvement of training for Rangers and better job descriptions could considerably improve conservation and restoration work in these areas. However, as protected area's rangers' low wages are often insufficient to support a family, they have to look for additional sources of income even though a Ranger's position implies full-time employment. For example, on the national level 111 out of 228 rangers in a survey live along with their livestock within the protected areas [19].

The Bulgan river natural reserve would need to implement a conservation plan for the Dunzarian dace, as well as reinforce patrolling to limit illegal fishing on this endangered species.

Environmental policies, often banning nearly all uses and activities in these areas may not be adapted to the environmental protection of the lakes and their surrounding areas. Existing human uses should be taken into account and public awareness should first be improved. A possible solution would be to provide for more management flexibility in protected area governance, for example by establishing areas for herders, defining the number and species of livestock permitted, grazing location, size of area to be used and the number of days allotted to each permit. Schuerholz [11] emphasized the necessity of a proper representation of local herder families and other key resource users on the planning team for the elaboration of the management plans. The management plans should be guided by a long-term vision for the targeted area that truly reflects local interests and should be embedded in over-arching conservation objectives of a protected area.

When discussing the implementation of environmental rules local habits and needs have to be taken into account. Local interest and responsibilities should be enhanced; a national program for PA staff training and capacity building should be developed, and local staff should regularly be evaluated on their capabilities and knowledge. This cluster of basins, especially the lakes, is already well covered by protected areas; therefore emphasis should be on better management plans, including provisions for human activities inside the protected areas, which would significantly improve the protection and the restoration of the ecosystems.

3.4.5. Climate change

The arid plateaus of Central Asia are isolated from surrounding regions by mountains and desert. These high elevation mid-latitude areas are experiencing stronger warming recently with an increase in average annual temperature of 1.8ө C over the past 60 years, more than twice the global average. Moreover, annual mean temperature of permafrost has increased in the Khangai mountainous region, and spring high water period in the Mongol Altai Mountains starts 20 days earlier, in the Khangai Mountains 5-10 days. This is attributed to higher temperatures, leading to an earlier snow melt [10].

These changes might affect spawning period for fish such as Mongolian Grayling and Osmans which are valuable commercial species in the region. Further studies should be carried out to assess whether or not spawning periods happens earlier in the year. In this case fishing period should be changed as a consequence.

Impacts of climate change on the natural water flow in rivers are hard to predict for the Western basins cluster, due to the complexity of the system. Furthermore as variability of the river runoff is large, trends are difficult to detect. So far however, no evidence has been found on changes in the runoff in Mongolia during the past 40-60 years.

Melting of glaciers might (temporarily) lead to an increase of summer run off in some rivers, especially in mountainous area. The glacier area of Mongolia already shrunk by 22.2%, river runoff which takes origin from glaciers is increasing and water levels of lakes fed by glaciers is also is rising.

Migration of fish and other aquatic species between rivers and lakes is vital in the Western basins cluster region. As the connectivity between lakes and river channels is one of the key factors for a wide variety of species and biological cycles, slight changes in run-off at certain periods of time could lead to a loss of connectivity and have great impacts on flora and fauna throughout the basins.

Even if lake levels of Uvs Nuur decreased in the past 15 years, long term monitoring shows that the lake level increased by more than 1m during the last four decades. Water balance components of the Uvs Nuur show that annually evaporation is at par with inflow. Increasing air temperature and wind speed might lead to a higher evaporation but at the same time increased inflow of cold water from glacier melting reduces evaporation.

Many of the lakes in the Great lakes regions are wide and shallow (<2 meter deep), consequently they are very sensitive to changes in evaporation. Their high area-depth ratio causes the water to warm up rapidly, increasing evaporation, which could lead to drying up of many small lakes if combined effects of climate change and increase of water withdrawal continue. Drop of water levels on shallow lakes will have an impact on willow stands, which are vital habitats for several species of fish and birds.

3.5. Human activities linked to the aquatic ecosystems

3.5.1. Domestic uses

The territory of the Western basins cluster covers 18% of the area of Mongolia, and its population of about 320,000 represents about 14% of Mongolia's total population. The average population density of approximately 1.2 persons/km$^{2.}$ With such a low population density the impacts from domestic uses are expected to be very low. However, about half of the population of the basins lives in the main aimag centers, and point source pollution has been locally observed around populated areas. Spring flooding carries household wastes into the rivers and lakes, but no studies have been found to assess the possible impacts on water quality. During the snowmelt period the dilution capacity is very high, and the impact of these events may be relatively insignificant on the basin scale.

3.5.2. Agriculture and irrigated areas

More than one fourth of all irrigation schemes constructed in Mongolia between 1958 and 1990 are located in the Western basins cluster, mainly near the Khovd and Buyant rivers. [20]. There are no reports available on the use of fertilizers in the irrigation areas. Most of the irrigation schemes were designed to divert surface water from river through an open channel system. In October, 2009 an estimate was made of the quantity of water used for irrigation. According to this estimate about 150 million m^3 from the Khovd River and its tributaries were used for irrigation in the summer time. About 133.5 million m^3 from the Buyant River were used for the same purpose. Due to water withdrawal for irrigation, the Buyant River is reported to fall dry near its confluence with the Khovd River during summertime [10].

Some irrigation systems in the upstream range of Buyant river have gone out of operation due to lack of management and maintenance, but in many locations surface water is still being diverted from the river through these canals altering the natural flow regime of rivers. Most of the systems, especially around Khovd aimag center are still in use. Low irrigation efficiencies are reported from the area. The volume of water diverted from the rivers is often exceeding the crop water needs. A better management of the irrigation systems and maintenance of water diversion infrastructures, especially near Khovd aimag center, would help reducing the volumes used for irrigation. However the impact of these irrigation systems is very local as excess water irrigated percolate to shallow aquifers or flow back to the river.

As mentioned earlier, slight changes in water levels disrupt connectivity between river channels and lakes in the Western basins cluster. Parts of rivers fall dry, and this could cause problems for fish migration and impact habitats, especially riparian vegetation. In the upstream part of the basin, restoration works to prevent diversion of rivers through irrigation channel should be carried out if existing irrigation systems are not intended to be restored in the (near) future. Downstream, better governance of irrigation activities, and appropriate withdrawal of water from the river channels in accordance with the actual water needs, would help to reduce the impacts on the natural river flow.

3.5.3. Pasture

Changes in the composition of the herds and pasture practice have been observed during the two last decades. Like in the rest of Mongolia, the pastureland in the Mongol Altai mountain range has been severely overgrazed lately.

If the current rate of pastureland use and overgrazing continues, the desertification and deterioration of vegetation cover will further intensify throughout the ecosystem. When vegetation cover deteriorates, the soil structure degenerates, water holding capacity reduces and nutritive soil layers are 'washed out' rapidly and in turn exacerbating the deterioration of the vegetation cover.

Willow stands along Khovd and Buyant Rivers are threatened with extinction due to grazing by livestock [21]. Ariunsuren et al. [22] revealed that the most pronounced degradation of vegetation succession (natural evolution from pioneer species to higher plants) in the flood plains is caused by excessive grazing. Strauss et al. [23] also report that most of the original vegetation, including forests and shrublands, have already been destroyed, blaming the impact of overgrazing for this loss of vegetation.

It may be assumed that the loss of shore vegetation equally occurs in the rest of the basins, especially as current pasture practices lead to higher concentrations of livestock around water bodies. This can be explained by the (partly) abandoning of rotation practices [8] and the rapid decrease of functioning wells in the region, which forces herders to concentrate their herds in the vicinity of rivers and lakes.

Even if the rate of loss of functioning wells in these river basins is not exactly known, several studies have been reporting a lack of maintenance on wells since the 1990s. Batbold et al. [24] reported that approximately 2000 wells had not been maintained since 1991. Improving the water availability for livestock would facilitate a better distribution of livestock over the basin, reducing the negative effects around rivers, lakes and floodplains, especially on riparian vegetation (see box below).

Recently Maasri [25] reported that extensive grazing practiced in this region lead to extensive watershed and bank erosion and an increase in concentrations of suspended particles and orthophosphate in the stream system. This is confirmed by the research of Shinneman that assessed increasing concentrations of phosphorus in lakes nearby urban areas over the last two decades, even in protected areas. As biological production of lakes in the Western basins cluster areas is limited by phosphorus concentrations, a rapid eutrophication of this water bodies should be expected in the near future.

Loss of functioning wells and impacts on water quality and ecology

Among the approximately 35,000 groundwater wells constructed in Mongolia before 1990, at least 60% were no longer functioning by 2000. Herders have then to rely much more on surface water, and tend to limit pasture rotation to areas in the vicinity of lakes or rivers. Concentration of livestock increases soil degradation and erosion in the floodplains, risk of water contamination via their dungs, impacts on riparian vegetation (especially around lakes) and competition for water between livestock and wildlife as well.

Restoring wells could lower pasture pressure and irremediable land degradation in some areas. However one of the drawbacks could be that increasing the number of functioning wells would be followed by an increase of livestock, hence land degradation. Restoration of wells should go with a limitation of livestock number in riparian zones severely affected by land degradation.

No studies have been carried out yet on these impacts on ecology, but we can expect that livestock increase the risk of degradation of water quality and habitats, e.g. for fish as fine particles will clog spawning habitats. The health of the nomadic population, as well as livestock production could be threatened as eutrophication can increase bacteriological contaminations and risks of toxic algal development.

3.5.4. Industries-mines

Compared to the other clusters of basins, mining activity is low in this cluster. No data are available to assess illegal mining activities, however, there are indications that exploration for natural resources, particularly for gold and gravel, has been increasing rapidly. Since the region has confirmed reserves of gold and tungsten, it is fair to expect that exploitation will increase in the region.

Depending on the process of extraction, release of toxic effluents could occur. Even if the release of toxic substances might be below toxic levels for fauna and flora in the rivers, these substances are likely to accumulate and concentrate in lakes and in river sediments.

Lakes are known to be sites where bioconcentration of toxic substances (e.g. heavy metals) occurs, especially in fish as these are on top of the food chain. In other words, even if concentrations of toxic substances in surface water are insignificant, concentrations can rise above toxic concentrations in fish tissues. This would lead to fish mortality and decrease of fish production in the lakes. Furthermore, as fish seems to becoming more and more popular for human consumption or export in this region, this is likely to affect human health as well.

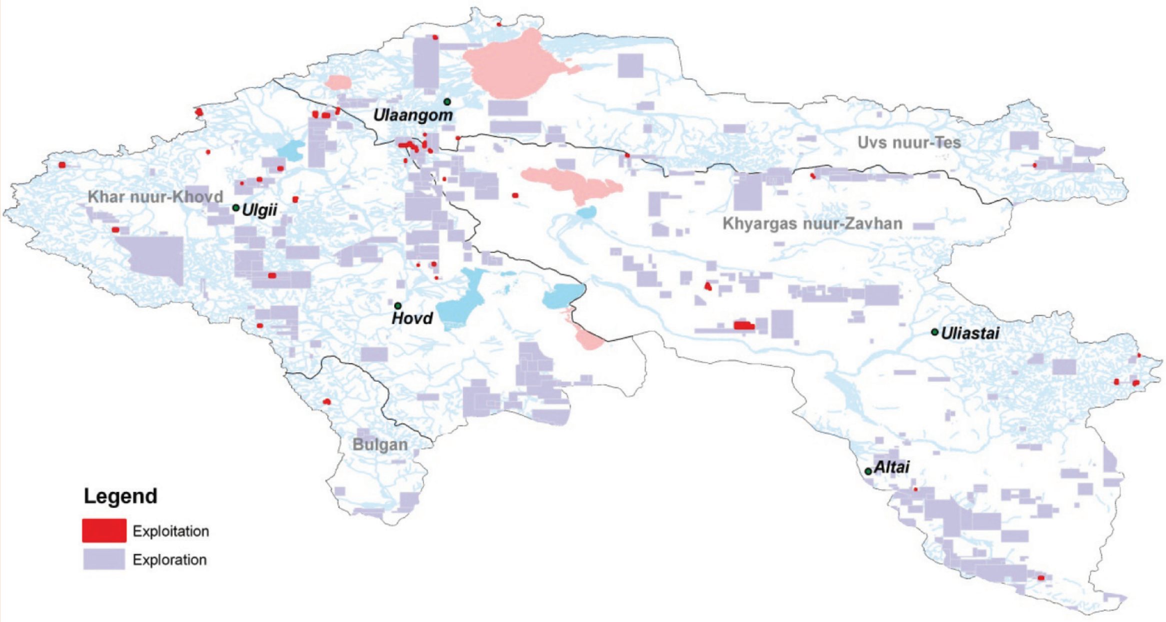

Figure 10. Mining exploration and exploitation in the Western basins

A study should be carried out to evaluate fish tissue content with respect to heavy metals and other toxic substances, as well as eating habits of fishermen and the lake shore population in general. If the current exploration leads to an intensifying of mining exploitation, ecological monitoring should not be limited to the vicinity of the mines but should include water quality of the lakes downstream as well.

Apart from mining activities, industrial activity is low in these river basins. In urban areas, some impacts of tanneries are reported, as hides are washed along the river banks, but effects on water quality are very local. No other point-source pollutions from industrial activities have been reported in this area.

3.5.5. Forest management

Trees are not cut only for reasons to increase and improve grazing grounds but also to meet the timber requirements in the Western basins cluster south of the larch forest belt.

In general the forest cover in most of the basins is very low. Also in the future the expected use of forest is relatively limited. Forested watersheds are less prone to erosion caused by grazing pressure. Destruction of these forested areas, even on a limited scale, will increase soil erosion and lead to higher concentrations of fine particles in streams. This will subsequently lead to reduced concentrations of nutrients such as phosphorus, and dissolved oxygen in the water. Furthermore, the loss of forested areas results in a loss of moss plants, which retain large amounts of moisture.

Heavy exploitation of riparian vegetation in the Khovd-Nuur Tes basin has been reported [20]. Riparian vegetation and its associated root system are known to limit nutrient transfer from the shores to the river beds. The increase of livestock concentrations along the streams and the rivers, combined with the decreasing self-purification capacity resulting form the over-utilization of riparian forest cover will accelerate the eutrophication process, especially in lakes downstream.

There is no long term monitoring taking place yet on the utilization and condition of the riparian vegetation in the Western basins cluster. Considering the rising concentrations of nutrients reaching lakes increasing eutrophication, especially in shallow lakes, a sustainable management of the riparian vegetation is needed. Locally, the ban on use of the area within 200m from the river channel is in effect, but enforcement of the ban is irreconcilable with prevailing pasture use while demarcation does not exist either. Improving public awareness and consultation with herder families on establishing sustainable pasture practices within this area is likely to yield a better result.

3.5.6. Tourism

The main tourist activities related to water are bird watching and fishing, but the remoteness of this region and the lack of transport infrastructures limit tourist activities. In this region tourism is not (yet) a significant degrading factor with respect to the environmental conditions. Tourist attractions in the region are fishing and bird watching, thus conservation of habitats is important to maintain the attractiveness of the region.

3.5.7. Fishing

Fishing and fish farming sectors were not well developed in the Western basins cluster. Main commercial fish species are Bigmouth Osmans and Mongolian Grayling, which both are classified as `Vulnerable species` according to the IUCN criteria. In 1999, Dulmaa stated that Osmans were not commercially fished in the Great Lakes Valley. He estimated the potential yield in the lakes at 500 ton/year. [26]. According to Erdenebat [20] the Altai Osman and Mongolian Grayling represent around 70% and 30% of commercial fish in lakes of the Bayan-Ulgii aimag, respectively.

Recent studies report that recreational and commercial fishing have increased, but little is known about the economic value, fishing procedures, size and species that are caught. As fishery potential is quite good a new assessment of the socio-economical value of fishing in the Great lakes basins should be carried out.

A recent study showed a 19% decrease in fish stock in Khar Us Nuur [27]. Reasons for this drop of productivity have not yet been identified, but could be a combination of overfishing and degradation of habitats caused by overgrazing near rivers and lake floodplains. Gilbert [5] reported large scale uncontrolled fishing in winter and destruction of fish habitat by drag nets used by fishermen in Khar us Nuur. Also a significant change in location and distribution of fish in the lake has been observed. It is quite likely that fishing activities have increase in other lakes as well.

A drop of the Osman population presents an issue considering the commercial and recreational uses, providing income for the local population. The protection of Osman population and habitats is necessary to ensure its sustainable commercial use.

Information on the average capture size is not available. Osmans reach their sexual maturity late (when 8-9 years old for Bigmouth Osman). Massive withdrawal of younger Osmans would severely impact the regeneration of stocks for several years, dramatically decreasing food and economical resources for local people. Fishing policies should thus focus on the regulation of capture size to ensure the sustainability of these fish populations.

Dates of allowed fishing period seem coherent to protect fish during spawning period. However difficulties to enforce this ban have been reported [13].

In the Bulgan basin, illegal commercial fishing is reported to be the major threat for the endangered Dzungarian Dace. No data are available on the fishing pressure in this basin. As no migration of this specie can occur from other basins, control should be reinforced in this basin to avoid the loss of this endangered specie.

3.5.8. Dams and flow regulation

Nine of the thirteen Mongolian hydropower plants are located in the Western basins cluster, more specifically in two river basins: Khar Nuur-Khovd (3 hydropower plants) and Khyargas Nuur-Zavkhan (6 hydropower plants). They represent almost 93% of the national hydropower production capacity (2008).

Dams can affect the natural river water and sediment flow and prevent fish migration. Durgun dam has an impact on the Chono-Kharaikh River at different levels. The natural flow regime is disturbed, as flow regime downstream of the dam is mainly governed by electricity production needs. The absence of natural fluctuations will have major impacts on the down stream habitats which are known to be the spawning sites for the population of Mongolian Grayling in Har Nuur.

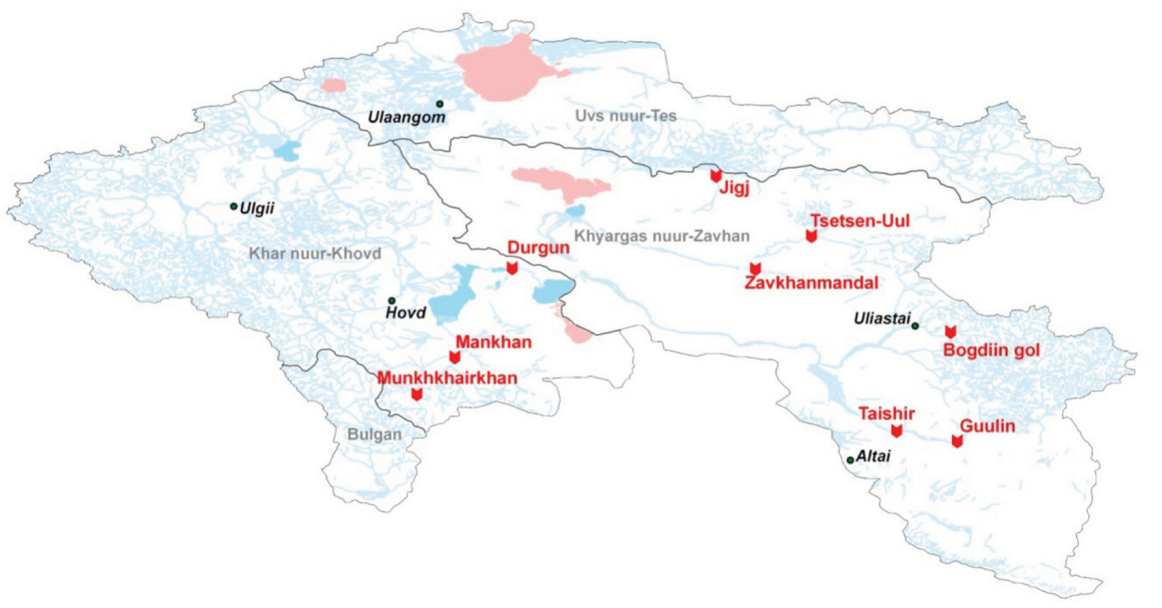

Figure 11. Location of hydropower plants in the Western basins cluster

Table 8. Hydropower plants in the Western basins

Name	River	Basin	Capacity, *kW*	Estimated head, *m*	Fishway	Flushing-gate
Taishir	Zavkhan	Khyargas Nuur-Zavkhan	11,000	43,5	Yes	Yes
Guulin			400	40	No	No
Bogdiin gol	Bogd		2,000	35	Yes	
Tsetsen-Uul	Galuutain		150	3	No	
Zavkhanmandal	Hungui		110	3		
Durgun	Chono-Kharaikh	Khar Nuur-Khovd	12,000	13,5	Yes	Yes
Mankhan	Khoid Tsenkher		150	11	No	No
Munkhkhairkhan	Tsenkher		150	10		
Jigj	Jigj	Khyargas Nuur-Zavkhan	200	17		

The Taishir dam was built on the Zavkhan river in 2008 and is located about 400km upstream from Airag Nuur. Several studies reported a decrease in water levels downstream of the dam site after its construction; Gilbert reported that Zoost Nuur became isolated from the rest of the water system as the channel between Zoost Nuur and Airag Nuur disappeared. Dropping water levels of Airag Nuur could eventually lead to a change of flow direction between the freshwater Airag Nuur and the brackish Khayrgas Nuur. This would change the water composition of Airag Nuur, affecting its ecology. The role of the dam in this process has not been established clearly yet but as Zavkhan river is the major contributor to the lake system, any change of the natural flow would have an impact on the lakes downstream.

Fishways have been incorporated in the Taishir and Durgun dams. For the Durgun dam, the fishway has been reported to be ineffective as the discharge inside this channel is too high for fish to swim upstream. The fishway design is possibly not appropriate for Mongolian Graylings either. A study would need to be carried out to assess whether or not solutions could be found to increase the fishway effectiveness with regard to the Mongolian Grayling.

3.6. Summary of the pressures in the Western basins cluster

Pressures are concentrated in the vicinity of the great lakes, where most of the economic activity occurs. Recent changes include the concentration of livestock near surface water bodies, a sharp increase of illegal commercial fishing, and the construction of several hydropower plants. Mining activities are not widespread yet in this region, but a major area is under exploration.

From the available data it can be concluded that groundwater quality does not everywhere reach the Mongolian requirements. Too high levels of mineralization are reported for both shallow and deep aquifers, especially in Khyargas-Nuur-Zavkhan basin. Nitrite and ammonium concentrations seem to be an issue as well and could form a threat to human and livestock health. However, the available data are somewhat inconsistent and cannot be considered completely reliable. A closer look when new data become available will probably confirm these hazards, especially regarding deep aquifer.

Climate change is expected to have a significant effect in these basins as melting of the glaciers will temporarily increase the discharge of the rivers upstream, but rising of temperature might lead to the reduction of the numerous shallow lakes and reduce surface water availability for wildlife and livestock. Because the number of operational wells significantly reduced over the last few decades, livestock has been more and more relying on surface water bodies. Overgrazing is the predictable result in the vicinity of these water bodies, increasing erosion and degrading water quality. Without reducing the overall number of livestock the rehabilitation of wells, accompanied with a proper management of the pasture areas seems the best solution to reduce the pressure of livestock on surface water bodies and surrounding land,. In protected areas, a better definition and control of the livestock capacity in buffer zones is needed to avoid irreversible land degradation and a net loss of grazable area.

Commercial fishing provides a valuable income for the local population, but lately the current fishing pressure exceeds the capacity of the lakes, and impacts the stock of vulnerable species. This activity presently occurs within the national conservation park and strictly protected areas, where fishing is actually forbidden. The lack of staff and equipment constrains the enforcement of the environmental laws. In order to achieve both, the protection of the natural resources and allowing economic activities, an option is to legalize fishing within the framework of implementing a proper management plan for the fish stock that includes control of the catches, the capture size, the fishing periods and the monitoring of the different species of fish stock. Fees from fishing licenses can be used for implementation of the monitoring, the rehabilitation of habitats and reinforcing the patrolling for illegal fishing.

The recen construction of dams has a range of impacts on aquatic species as a result of the perturbation of the natural flow and loss of habitats. Dams not only disturb aquatic species but also change the uses of the floodplain. Loss of pasture area is quite obvious upstream of the dam but there is little information on how dams affect the floodplain downstream of the dams. The reduction of natural flood events has certainly an impact on vegetation and richness of the pasture area downstream. A survey on vegetation changes downstream of dam sites could bring valuable information to understand how dams affect pasture areas. This would provide valuable input to anticipate and limit the impacts of planned dams on pastoral activities.

Table 9. Main pressures in the Western basins cluster

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services
Climate change	Increasing glacier melting, leading to an increase of discharge in mountainous areas in the near future. Increasing evaporation as well specially in shallow lakes	Changes in surface water flow and lake levels. Loss of soil moisture and land degradation especially in floodplains.	Water availability for human and livestock, especially around shallow lakes
Increase of livestock number and concentration in floodplains and around water bodies.	Overgrazing, increasing land degradation	Erosion and increase of turbidity in surface water. Destruction of riparian vegetation and aquatic habitats. Eutrophication in the lakes	Irreversible destruction of pasture areas. Locally, possible bacterial contamination of surface water, especially around urban areas. Impact on habitats for fish leading to a loss of commercial fish stocks.
Commercial fishing	Over fishing of vulnerable species (Osman and Mongolian Grayling) in freshwater lakes, and endangered Dunzarian Dace in lower part of Bulgan river basin.	Decrease of the fish stock in lakes, impacting endangered populations of Osmans and Mongolian Grayling. Possible impact on bird food source.	Massive drop of fish stock for commercial uses. Potential impact on tourist activities (fishing and bird watching)
Introduction of invasive species	Introduction of muskrats for commercial use (fur).	Destruction of riparian vegetation, loss of habitats in Khar Us Nuur and Har Us Nuur.	Decrease of habitats and loss of fish stock. Impact on riparian vegetation used for livestock and firewood.
Dams	Disruption of connectivity. Changes of natural flow, destruction of spawning sites downstream and upstream. Threatening environmental flow	Impacts on natural habitats and spawning sites for fish upstream and downstream. Decrease of lake levels downstream, increase of lake levels upstream.	Impact on fish stocks. Loss of self-purification capacity Loss of pasture area (Dali Nuur).
Loss of riparian vegetation	Over utilization of riparian vegetation for domestic uses	Destruction of riparian habitats. Increasing erosion of the river banks, especially on the lake shores	Impact on habitats for fish leading to a loss of commercial fish stocks. Loss of self-purification capacity

4. Western Gobi Basins Cluster

4.1. The river basins

Figure 12. River basins of the Western Gobi basins cluster

4.1.1. Geography

The River Basins of the Western Gobi cluster belong to the Central Asian closed basin, with the Gobi-Altai mountain range as its northern boundary. Altain uvur Govi is considered as a groundwater basin, whereas Uyench-Bodonch and Huisiin Govi-Tsetseg Nuur river basins combine groundwater and a surface water network system. The relief is composed of a high density of mountains and hills in the northern parts of the basins, while wide flat land covers the southern parts.

The Gobi-Altai mountain range accumulates high amount of snow during winter time and there is where most of the precipitation occurs (average precipitation of 140mm in the northern part of the Altai). Springs are concentrated in the mountain massifs and low hills, while the region's plains and rolling terrain are largely devoid of surface water. The southern regions of this cluster are characterized by a special zone of stone-covered super-arid desert where vegetation is largely absent.

This region is sparsely populated with stockbreeders of camels, goats and sheep that are adapted to scarce vegetation. The southern part of the cluster exhibits flora and fauna typical of the deserts of Central Asia. Desert steppe species are found primarily at higher elevations, and saxaul forests occur on mountain slopes.

4.1.2. Land cover

Land cover is dominated by desert, desert steppe, and saxaul forests occur on lower elevation along the dry river beds and sandy surfaces. Steppe vegetation covers the floodplain along temporary river beds, where soil moisture is created by temporary run off, but is really scarce in the other parts of the basin.

Table 10. Western Gobi basin- Land cover

Basin	land cover (% of basin)				
	abandoned land	bare land	shrub forest	pasture land	settlement
Altain uvur govi	-	2.6	15.7	81.7	-
Huisiin govi-Tsetseg Nuur	2.3	-	2.4	95.1	0.2
Uyench-Bodonch	-	1.4	18.6	80.0	-

Source: National Atlas - 2009

Source: National Atlas - 2009

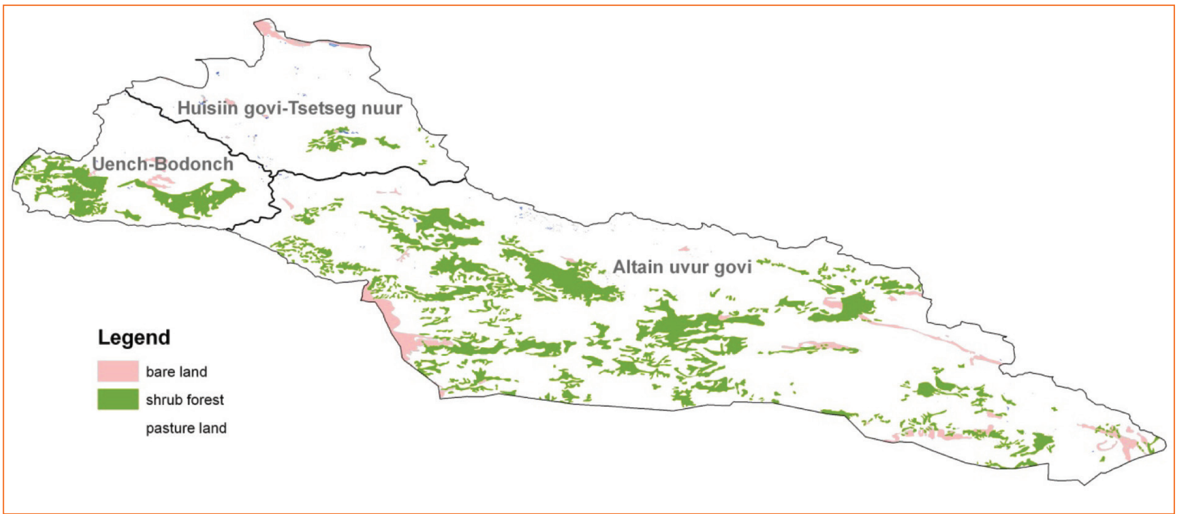

Figure 13. Land cover of the Western Gobi basins cluster

4.1.3. The river network

Surface run-off occurs as a result of snowmelt and after rain storms in the mountainous regions. River orders are low. The temporary streams eventually infiltrate the soil, recharging shallow aquifers, or evaporate. However some oases are found in closed depressions and along dry riverbeds, where aquifers reach the surface naturally.

Open water is unevenly distributed. Many streams and mountainous lakes can be found in the northern part of the basins that are fed by snowmelt and rainfall. In the Dzungarian Gobi, open water is sparse, but springs tend to be permanent. In the Transaltai Gobi, open water is uncommon and except for a few large oases, smaller water points usually dry up seasonally or sometimes for years. Although the southeastern Gobi receives the most precipitation, the availability of open water varies very much between years and within the years [28].

4.2. Surface water quality

4.2.1. Monitoring network

There is very little information available on surface water quality in these basins. Two stations in Huisiin govi-Tsetseg Nuur and three in Uyench-Bodonch river basins monitor surface quality but data could not be obtained for this report. No data could be obtained on water quality in the oases.

4.2.2. Trends in surface water quality

Surface water quality has been reported to be highly mineralized (around 700 mg/l) but due to the temporary nature of most of the streams a clear picture of trends in surface water quality in these basins cannot be drawn.

4.3. Groundwater quality

4.3.1. Monitoring network

Analysis of water chemistry has been carried out for shallow and deep groundwater wells, between 1968 and 1990. Some data on nitrogen-based molecules such as nitrate, nitrite and ammonium are available. However the data are not sufficient to determine trends with any authority and draw conclusions on this issue. No data on bacteriological analysis or heavy metal content are available.

4.3.2. Trends in groundwater quality

Mineralization is high in shallow aquifers (around 800 mg/l) and in deep groundwater (average above 900 mg/l). Levels of mineralization exceed the standards (1000 mg/l) for drinkable water in many shallow and deep aquifers.

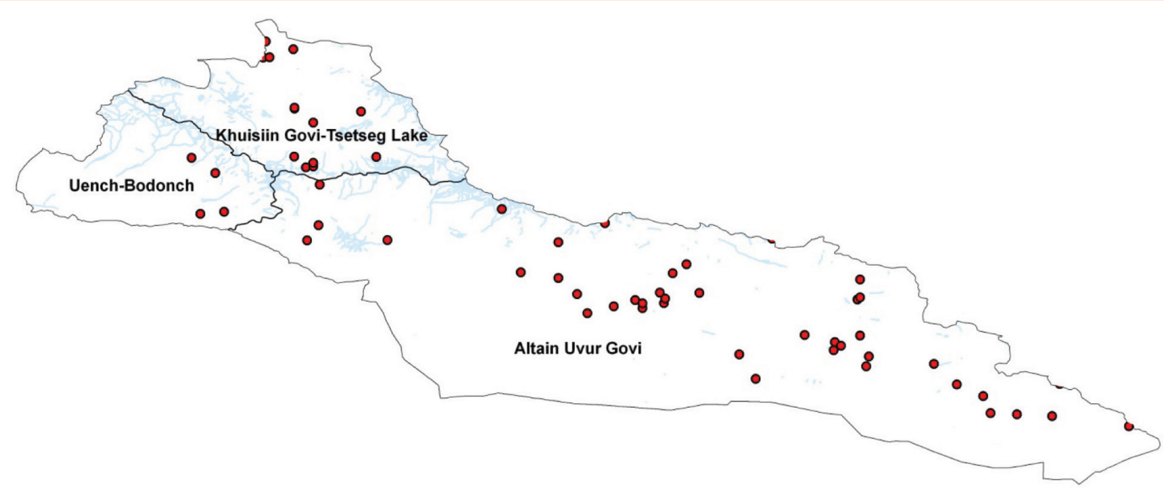

Figure 14. Location of wells where mineralization exceeds 1000 mg/l in the Western Gobi cluster

From monitoring data it appears that SO_4^{2-} is the major ion with HCO_3^-. The mean pH value is around 7.1. The high sulfate content (on average around 300 mg/l, with in extremes cases op to several grams per liter) is certainly not due to human activities as it derives from the dissolution of soluble SO_4^{2-} and S minerals in sedimentary rocks. Numerous water samples contained concentrations exceeding 400 mg/l (Figure 15), which is the permissible limit for drinking water according to the Mongolian Standards. High sulfate content can trigger human health problems. People who are unaccustomed to drinking water with elevated levels of sulfate can develop diarrhea and dehydration. Infants are often more sensitive to sulfate than adults. Animals are also sensitive to high levels of sulfate. In young animals, high levels may be associated with severe, chronic diarrhea, and occasionally cause death. As with humans, animals tend to become tolerant to sulfate over time.

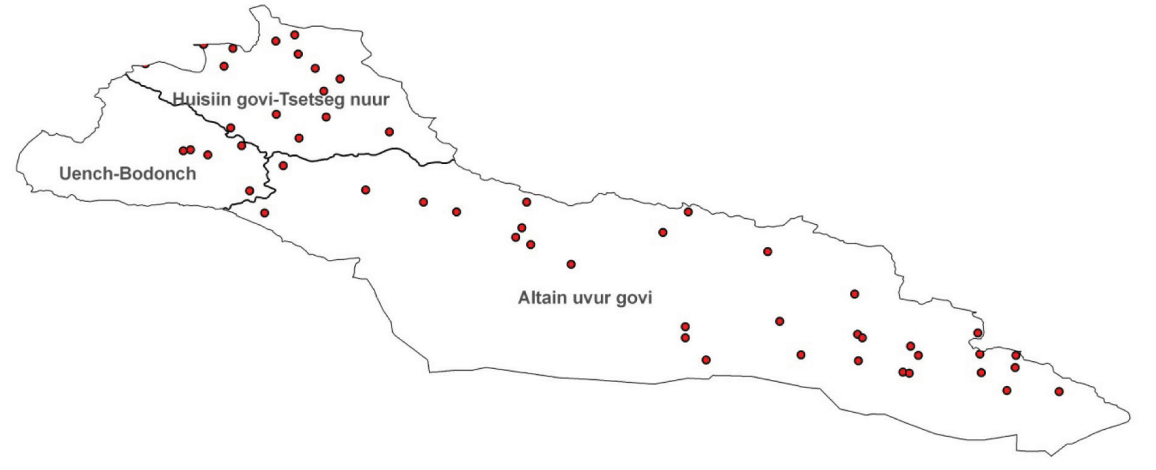

Figure 15. Location of wells where SO_4^{2-} exceeds 400 mg/l in the Western Gobi cluster

High nitrite concentrations (>1 mg/l) have been reported in shallow and deep aquifers the western edge of the cluster (Figure 16), but this need to be confirmed by more recent data.

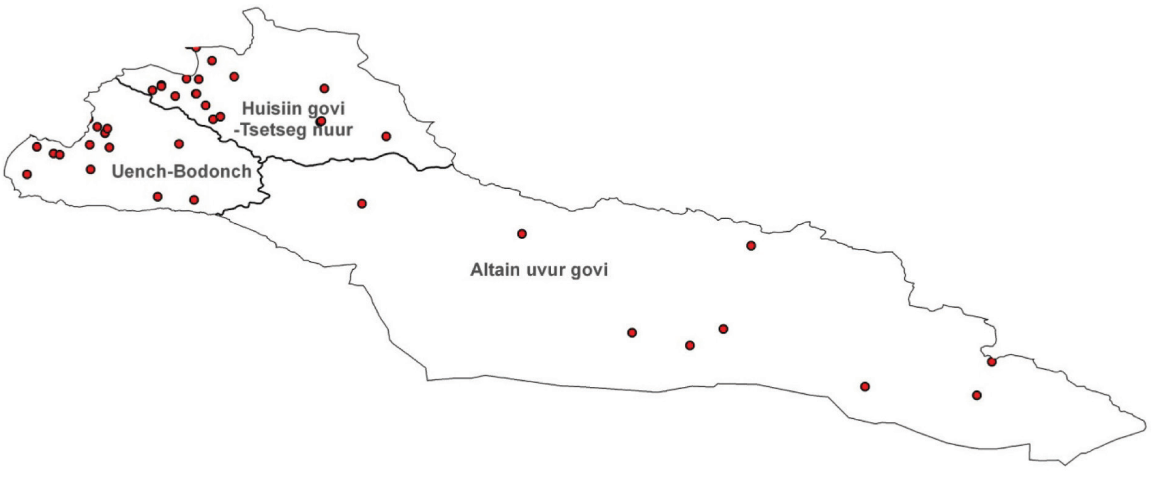

Figure 16. Location of wells where NO_2 exceeds 1 mg/l in the Western Gobi cluster

No data from sanitary analysis have been collected.

4.4. Ecological conditions

4.4.1. Ecological monitoring

No studies have been found regarding aquatic ecology in the temporary surface water bodies or oasis.

4.4.2. Aquatic ecology

No information is available on aquatic species in these basins.

4.4.3. Terrestrial ecology

There are many endemic and endangered species of mammals present in these basins. The population of the critically endangered wild Bactrian Camels (Camelus bactrianus ferus) is estimated at less than 1000 animals. The Gobi Bear (Ursus arctos gobiensis) is another critically endangered species of the region, with a population estimated at 30-40 animals. The Wild Ass and Goitered Gazelle are considered endangered species as well. Mountainous areas in the northern part of this region support endangered populations of Snow Leopards, Ibex and Argali.

Drying up of water sources and droughts threaten these species, although it remains unclear if these represent natural environmental changes or are driven by anthropogenic activity. However concentration of human activities and livestock around the surface water bodies, especially in the flat steppes area, creates perturbations and might limit water availability. This could restrict available habitats for the wildlife species.

4.4.4. Zones with a specific ecological interest

The Great Gobi A and B Strictly Protected Areas, a part of the Small Gobi Strictly Protected Area and the Gobi Gurvan Saikhan National Conservation Park are the 4 main protected areas in this cluster of basins. A few smaller nature reserves are situated in the north western part of the region.

Increasing aridity and competition for access to water in the surrounding deserts have added to the value of these ecosystems in providing refuge for a number of species.

The Great Gobi A and B Strictly Protected Areas encompass the habitats of many endangered species such as the Snow Leopard (*Uncia uncia*), Ibex (*Capra sibirica*), Argali Sheep (*Ovis ammon*), Saiga Antelope (*Saiga tatarica mongolica*), Gobi Bear (*Ursus arctos gobiensis*). The desert habitat of the few remaining wild Bactrian Camel (*Camelus ferus bactrianus*) is located in the southwest of Omnogovi aimag.

Although pasture is banned in the core zone of the strictly protected areas wild animals and livestock do compete for water in core zones. Kaczenskya discovered that the mere presence of people and their livestock at watering points limited or even blocked access for Asiatic Wild Asses, and we can safely assume similar impacts on other wildlife species [28]. Competition for water increases when availability of surface water reduces and lack of maintenance of wells forces herders to rely more on surface water bodies. Rehabilitation and installation of wells, and better management of the buffer zones around the protected areas, are likely to reduce competition for water.

Figure 17. Zones under national protection status in the Western Gobi cluster

Patrolling and monitoring is commonly lacking in all the strictly protected areas in these basins. Occurrences of illegal mining have been reported in the Great Gobi strictly protected areas and in the Govi Gurvan Saikhan national conservation park. There is little evidence of overgrazing in the strictly protected areas, except in Gobi Gurvan Saikhan were livestock numbers are twice the carrying capacity.

No RAMSAR sites have been designated in these 3 basins.

Four important bird areas (IBAs) [29] are situated on the edges of this cluster, but their areas located in the river basins are very limited. These IBAs don't have a direct link to aquatic systems, as the birds observed do not nest in the vicinity of rivers or rely on aquatic species for food.

4.4.5. Climate change

Like the national trend, the temperatures in these basins are expected to increase. Nearly all climate models suggest an increase in precipitation as well in particular during the winter. Rainfall variability is expected to increase with more storms of higher intensity that would increase surface runoff ponding more often. However the increased temperatures lead to higher evaporation rates depleting the temporary water bodies faster. The net effect on water availability and groundwater volumes is unknown and very much depending on local circumstances. Surface water bodies in the south of the basins might suffer from the increase of evaporation, which will decrease surface water availability for livestock and wildlife.

4.5. Human activities linked to the aquatic ecosystems

4.5.1. Domestic uses

Density of population is very low in these basins. Pollution from domestic activities is not a widespread issue in this area. However, due to the decreasing number of functioning wells, herders concentrate more and more around surface water bodies which are very sensitive to any pollution due to their small size.

4.5.2. Agriculture and irrigated areas

Little information is available on the extent of cropping and irrigated areas in these basins. Reservoirs are been built for irrigation purposes in Tsogt sum, (Gobi Altai Aimag, Altain Uvur Govi River Basin). Vegetable gardening along the Ekhiin River, in Great Gobi A strictly protected area has been spotted. Even if this does not represent a significant impact of river levels or on water quality, such activities in a protected area can create perturbations to wildlife. If cropping is permitted it should be concentrated in specific parts of the protected area to avoid a spatial dispersion of perturbations that could lead to a fragmentation of wildlife populations.

4.5.3. Pasture

The dzud of 2009 decimated the number of livestock in these basins. Access to water is already a limiting factor of the pasture capacity, especially during winter time and as a result the casualty rate in this region was much higher than the national average.

Stumpp et al. [30] found no significant correlation between the distance from the water source and the plant species richness or vegetation composition in Bayandalay soum. The differences between sites of high and low grazing intensity were found to be small. He concluded that the high interannual variability in precipitation had much more influence on the vegetation than soil parameters and livestock grazing.

Some other studies contradict this hypothesis, reporting that in the desert zone plant species diversity decreased by 33% between 1997 and 2008. The increasing proportion of goats would be one the factor of these changes, but the lack of precipitation during this period may have been the driving factor for this loss of plant species.

Locally however, impact of livestock can be significant, especially in the vicinity of the scarce temporary water bodies in the basins. Trampling, grazing of the riparian vegetation and possible organic pollution from the livestock droppings can have a significant effect on the water quality, especially as their dilution capacity is virtually null. Bacteriological contamination might occur as in the other basins of the Gobi desert, where sanitary problems have been reported in temporary water bodies where livestock gathers. Moreover as mentioned earlier it creates perturbation with respect to access to water for wildlife.

Rehabilitation of wells in the region is likely to have considerable benefits for herders by increasing the area of pasture available for grazing, and potentially by reducing the labor and time required for watering, depending on the type of well used. If well rehabilitation were to be done with mitigation measures such as control of livestock number, it could also be beneficial to wildlife. For example, by spreading livestock out over a larger area, grazing impact and degradation of pasture could be reduced—assuming that overall livestock numbers would not increase. Wells also provide an alternative to the use of open water sources by livestock, potentially increasing access to water for wildlife. Controls on the timing of well use could also allow maintenance of movement corridors for migratory species. However, when such measures are not put into place, well rehabilitation schemes are potentially detrimental to wildlife populations.

4.5.4. Industries-mines

Illegal mining, mainly for gold, is widespread in these basins. More than 10,000 illegal mine placers were counted in Bayankhongor aimag [31] and placer gold miners were also reported in Gobi-Altai aimag. Illegal mining activities are more recent in this part of Mongolia (starting from 2004) than in the northern parts (dating from the mid-90s). Miners have even been sighted inside the Great Gobi strictly protected areas.

The use of mercury and cyanide for processing gold ore started recently in the area [26] and is a potential pollution hazard for soil and shallow groundwater.

No data have been found on groundwater contamination in these basins, however recent studies showed that shallow groundwater in the eastern part of the Gobi desert are heavily polluted although these hazardous substances have been used for just a decade. Contaminated groundwater takes decades to recover and no treatment is appropriate to remove heavy metals from the water. If the use of hazardous substance continues and even increases, serious problems for water safety should be expected. As of this moment it is not clear if and to what extent pollution is widespread and how these heavy metals disperse in these shallow aquifers. However as water resources are already scarce in the region, even a slight reduction of water availability will have impact on local population and livestock distribution.

Monitoring contamination by a wide range of heavy metals and a reinforcement of the ban on use of heavy metals are urgently needed to preserve groundwater quality.

4.5.5. Forest management

The lowest points of the basins, where the water table is higher are covered by scattered saxaul forests. Wood cut from the forests is mainly used for domestic purposes, such as construction or firewood. Saxaul forests are generally very thinly populated and growing very slowly in the harsh desert like environment. Even recovery from very limited cutting of saxaul is difficult and will exacerbate desertification and wind erosion. Impacts on water bodies are difficult to quantify.

4.5.6. Tourism

Tourism activities increased in the recent years in the region especially in strictly protected area buffer zones and in the national parks. It is not reported to be a serious issue at present. Nevertheless, as one of the main tourist activities is wildlife viewing, perturbation to wildlife might increase in the vicinity of water points where there are more chances to observe rare animals. Public awareness should be reinforced to control and limit such perturbation.

4.5.7. Fishing

No fishing activities have been reported in these basins.

4.5.8. Dams and flow regulation

One hydropower plant is located in the Uyench-Bodonch river basin. There is very little information on this hydropower plant, which is fed by snowmelt mainly. No fishway has been included in the structure but would certainly be not cost effective considering the small population of fish and the abundance of natural spawning sites that can be expected in this basin.

4.6. Summary of the ecological issues in the Western Gobi basins cluster

Besides a few perennial water bodies exist that are fed by shallow aquifers in depressions occasional surface run off occurs in the basins in the south-western part of Mongolia, Surface run off is driven by snowmelt and precipitation and ends up in temporary water bodies in depressions recharging shallow aquifers. Even though aquatic life is not very developed in these basins, surface water availability is essential for many rare and endemic terrestrial species in the western Gobi region. Variability of water availability will increase in a near future and pose a threat to their populations.

Surface water bodies are more and more used by livestock and the local population, as the number of functioning wells reduced rapidly over the last two decades. This triggers a concentration of pastoral activities around remaining wells and oases with a consequent loss of pasture areas. Competition for water is increasing between livestock and wild life especially in protected areas where herders tend to gather. A better management of the buffer zones in the strictly protected areas would improve the coexistence of pastoral activities and preservation of rare terrestrial species. Special attention is needed to solve these issues in Great Gobi A strictly protected area.

Groundwater quality does not meet the requirements for drinking water mainly due to high mineralization and sulfate concentrations that exceed the norms. Treatment to decrease mineralization are costly and difficult to implement taking into account the number of water points. High concentrations of nitrite and ammonium that have been reported in the western part of the region (Khovd aimag) await confirmation by a recent survey as some of the available data appear not very reliable. No signs of heavy metal pollution have been reported, but could happen in the eastern part of the region where illegal mining activities occur the most. If so, controlling the availability of heavy metals in the region would be more efficient than patrolling campaigns, as illegal miners shift places easily and frequently.

Table 11. Main pressures in the Western Gobi basins cluster

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services
Climate change	Increasing variability of precipitation Increasing evaporation	Decrease of temporary water bodies	Decrease of water availability for livestock and local population
Concentration of livestock in the vicinity of temporary water bodies and remaining wells	Overgrazing, increasing land degradation	Erosion and increase of turbidity in surface water. Destruction of riparian vegetation and aquatic habitats Competition for water between livestock and wildlife	Pollution of water sources Possible impacts human health
Mining activities	Illegal mining using hazardous substances	Pollution of shallow aquifer	Pollution of water sources, possibly irreversible

5. Eastern Gobi Basins cluster

5.1. The river basins

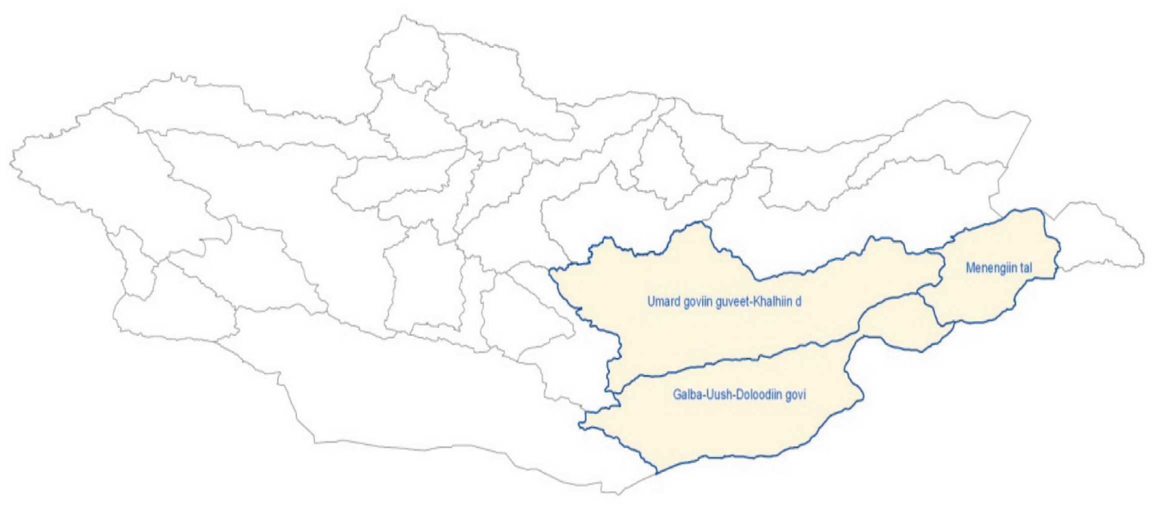

Figure 18. River basins of the Eastern Gobi basins cluster

5.1.1. Geography

Umard goviin guveet-Khalhiin, Menengiin tal and Galba-Uush-Doloodiin Govi basins are located in the eastern part of the Gobi desert, in the south eastern part of Mongolia. They are all considered ground water basins. Umard goviin guveet-Khalhiin and Galba-Uush-Doloodiin Govi basins belong to the closed Asian basin, while Menengiin tal is part of the pacific ocean drainage basin.

The climate is harsh, with temperature reaching up to 40˚C in summer and -40˚C in winter. Winters are very dry, with less than 10 mm/year recorded between 2005 and 2007. Precipitation occurs mainly in summer, with short and heavy rainstorms. Because most precipitation events during the summer season are the result of localized convection storms, random distribution of precipitation tends to create extremely local areas of high vegetation growth and higher surface water availability, changing from year to year. This is the windiest region of Mongolia with winds up to 140km/h and frequent sandstorms. Frequency of the sand storms has been reported to increase in the last decade [32]

Population density is low in these basins, and a few urban centers concentrate a major part of the population. The region supports important mining sites in its south western part, and will benefit of a major development of infrastructures in a near future. This will trigger more pressure on the ecosystems, with roads and railways being a threat to wildlife populations.

5.1.2. Land cover

Due to the harsh climatic conditions and the flat topography, the basins do not harbor a great variety of landscapes. Land is mainly covered by rocky pasture area, and few shrubs forest lay in depression of the southern part of region where shallow aquifers almost reach the surface. Soils are thin, with a low moisture capacity, and not readily arable. Wind is one of the limiting factors of plant growth with dust accumulating on leaves; Vegetation conditions are significantly influenced by the amount of precipitations but not so by changes in grazing pressure [28]. Due to the spatial variability of precipitations, distribution of vegetation cover and vegetation growth in these basins is highly variable from year to year.

Source: National Atlas - 2009

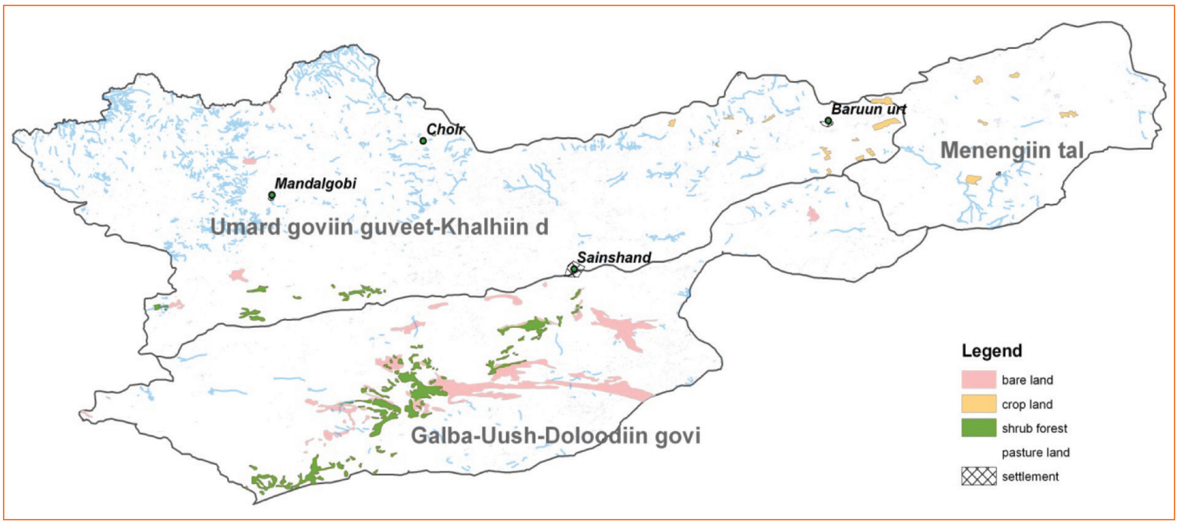

Figure 19. Land cover in the Eastern Gobi basins cluster

From the local perspective, land degradation is perceived as a very real concern. However according to a recent study the Gobi land cover did not change appreciably between 1960 and 2003 [33]. The lack of precipitation recorded during the last decade seems mainly due to a natural variability, increased by recent climate change. A Green belt project has been carried out and consist of planting trees to limit the supposed land degradation, but the surface covered is non significant compared to the other areas affected.

Table 12 Eastern Gobi basins cluster - Land cover

River basin	land cover (% of basin)							
	Abandoned land	Bare land	Crop land	Forest	Shrub forest	Pasture land	Settlement	Water
Menengiin tal	0.1		0.8			99.0		0.1
Umard goviin guveet-Khalkhiin Dundad Tal		1.4		18.6		80.0		
Galba-Uush-Doloodiin Govi	5.0				2.8	92.1	0.1	0.1

Source: National Atlas - 2009

5.2. Surface water quality

5.2.1. Surface water system

These basins have very little surface water network, mainly composed of temporary streams after summer rainfall. A number of permanent springs and temporary flowing streams occur within the numerous valley systems. The seasonal surface runoff flows into small lakes and saline playa systems. The temporary lakes and salt-marsh systems are evaporative basins, leading to a high mineralization of the water. Flows after heavy summer rain storms often result in very turbulent high velocity mud flows through ravines. These short term flood events can erode the river bed and deposit fine sediments within the discharge basin of the drainage system. On average, 4 to 6 flow events occur in spring to autumn and high velocity flow events usually last between 30 to 90 minutes [34].

5.2.2. Monitoring network

Very few studies report the water composition of the temporary surface water bodies in these basins.

Constant monitoring work on water regulation, quality and biodiversity of Ganga Nuur and Duut Nuur was carried out from 1982 through 1992 and then stopped. From 1997 Institute of Meteorology and Hydrology has started a monitoring work on water regime, quality and biodiversity of Ganga Nuur and Duut Nuur by establishing permanent water study posts around these area.

5.2.3. Trends in surface water quality

As streams are temporary and do not present a proper surface network it is not possible to establish a general description of their water composition. Streams are formed after heavy rainfall episode and highly erode river bed.

Perennial lakes have a high mineralization (2580 mg/l in Ganga Nuur) and high conductivity, for instance 5,420 and 12,460 μS in Ganga and Uizen Nuur respectively [35].

5.3. Groundwater quality

5.3.1. Monitoring network

Data are available for major ions, pH and sometimes nitrogen based molecules in some deep and shallow wells in the area. Data available for this report have been recorded from 1972 until 1990. The number of analysis on nutrient does not allow us to establish clear conclusions on the whole area, though. Changes of groundwater quality that can occur for shallow wells can not be determined with this set of data. A few one-time monitoring have been done recently on some points, including heavy metal analysis.

5.3.2. Trends in groundwater quality

Groundwater in these basins has a high mineralization, often exceeding the standard for drinkable water (Figure 20).

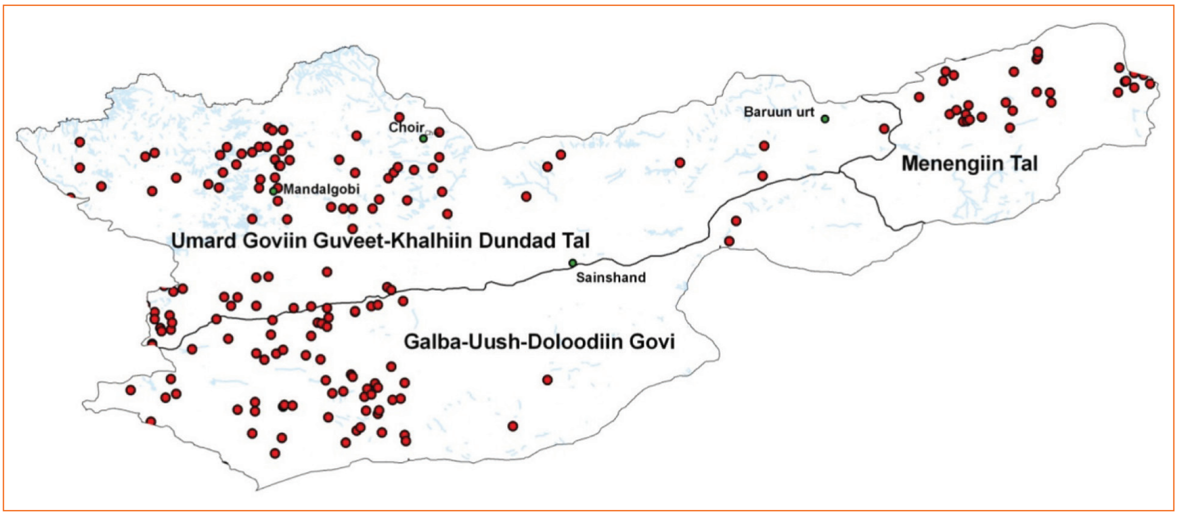

Figure 20. Locations of wells where mineralization exceeds 1000 mg/l in the Eastern Gobi basins cluster

This occurs not only for shallow aquifers but for deep aquifers as well. HCO_3^- and Na are the major ions in shallow and deep groundwater, though SO_4^{2-} is sometimes found to be the most concentrated ion. Values of sulfate exceeding the recommended value for drink water occur as well for shallow and deep aquifers (Figure 21). This can trigger health problems, mainly for children and limit the productivity of livestock, though no studies revealed sanitary problems in this region. Treatment processes to remove sulfate can be difficult to implement in remote areas.

Value of pH is around 7-7.6 with low variability. Nitrogen based molecules concentration shows a much higher variability; nitrate range from 0 to 40 mg/l, and concentration of nitrite reached up to 5 mg/l. No clear trend in time or spatial dimension can be observed with the data available, but it shows that shallow groundwater can easily be polluted, probably from livestock.

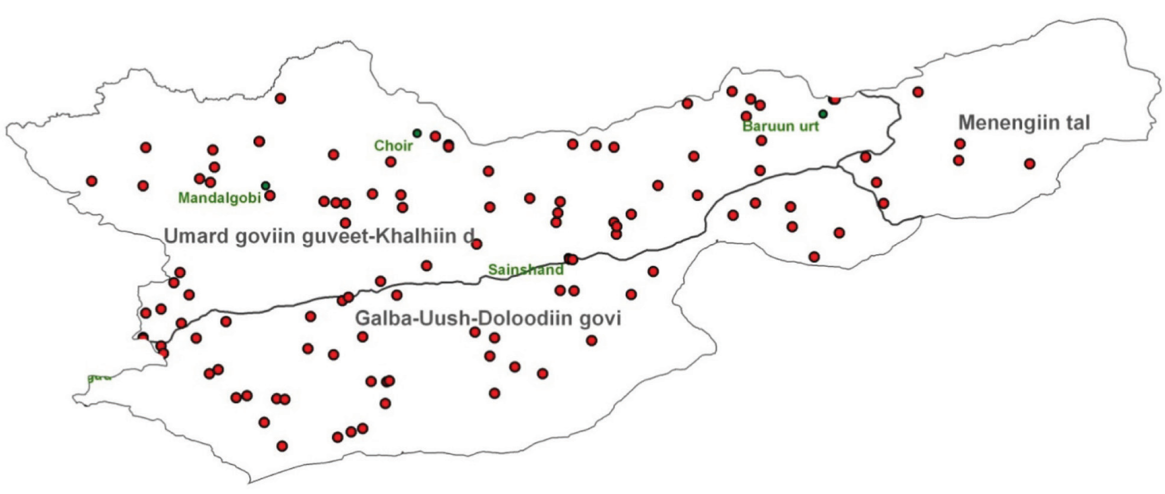

Figure 21. Locations of wells where sulphate exceeds 400 mg/l in the Eastern Gobi basins cluster

More recently, the content of cyanide and mercury in wells exceeded drinkable water quality standard by more than five times in Galba-Uush-Doloodiin Govi river basin (2004). We can assume that the use of hazardous products in mining activities can be a significant source of pollutants for groundwater. A general survey is lacking to determine the areas where groundwater is polluted by heavy metals.

5.4. Ecological conditions

5.4.1. Ecological monitoring

Due to the absence of perennial water system, Ecological Monitoring on aquatic species has not been carried out. Description of Ramsar sites brings us a one-time monitoring on flora and fauna of Ganga Nuur.

5.4.2. Aquatic ecology

No endangered fish species have been listed in these 4 basins. According to the RAMSAR Information Sheet, the Spiny loach- *Cobitis taenia*, occurs naturally in the Ganga Nuur [35]. In mid of 1980s Golden carp (*Carassius auratus*), Amur catfish (Parasilurus asotus), Europan carp (*Cyprinus carpio*) have been re-introduced (by supervision of doctor A.Dulmaa) from Tuul River to the Ganga Nuur. It is not clear if these fish species were meant to bring a valuable resource in the lakes, though the

Golden carp is known to be a commercial fish species. No recent data are available to estimate the distribution of fish population in the lakes.

Due to the temporary characteristics of the surface water system, fish tend gather in lakes. Drying up of rivers, decrease of water levels in lakes and loss of riparian vegetation due to the impact of livestock concentrating around water bodies may have high impacts on fish stock in the lakes.

5.4.3. Terrestrial ecology

The region harbors many endangered or vulnerable species of mammals and birds adapted to the specific conditions of the Gobi desert. The Mongolian Gazelle, wild ass, the Siberian marmot are some examples of endangered species which are found in this region. Threats to these species and to wildlife in general come in many: destruction, degradation or fragmentation of habitat; physical disturbance; competition with domestic livestock, illegal hunting and trade, but threats not related with aquatic ecosystems will not be detailed in this chapter.

Wildlife species all much rely on the presence of surface water and there populations are sensitive to surface water availability, such as springs and lakes. Competition for water has increased in the last decades. The drying up process of lakes, due to natural variability of precipitation, climate change, or human activities limits the distribution of water sources. Furthermore, more and more livestock gather around water bodies as many wells are not functional anymore. Number of ecotourist camps is increasing and are often established near watering places as well to increase the probability of animal sightings. Their presence disturbs wildlife and, if continued for several days, deprives them of water [32]. This reinforces disturbances on the remaining water bodies in the basins, and impact water availability for wildlife.

Competition with domestic livestock for water could be lowered if wells would offer a better access to water for herders. Maintenance of wells could dilute the livestock pressure, gain pasture areas and limit the concentration of livestock especially around lakes, where they cause destruction of riparian vegetation and valuable habitats for migratory birds. New ecotourist camps should be installed at a certain distance from water bodies known to harbor wildlife, and public awareness should be reinforced in national parks to limit the disturbance to wildlife.

5.4.4. Definition of zones with a specific ecological interest

Lake Ganga and its surrounding wetlands have been elected as a RAMSAR site since 2004. This group of lakes is the only place within the neighboring region, where many vulnerable waterbirds stay during the migration and some rare waterfowl breed in summer. The site supports the following generally threatened species: vulnerable White-naped, endangered Swan Goose, vulnerable Great bustard as well as Whooper Swan listed in Red Book of Mongolia and the very rare in Mongolia Little Curlew [14]. Besides, some fauna species are listed as endangered by the Mongolian Law on Wildlife, e.g. 2 species of Very Rare animals, 3 species of Rare animals; 4 species listed in the Red Book of Mongolia.

In all, 10 lakes in this region are included in the RAMSAR zone. However, Robinson [36] reported in 2004 that Erdene Nuur and Sumtiin Nuur, in the vicinity of Ganga Nuur, already dried out. The other lakes in this zones show a reduction of their area as well. Causes can be various and are not clearly established, but climate change may be the main driving factors, as shallow lakes are very sensitive to a slight increase of temperature leading to a higher evaporation. Land degradation in the area can lead to a higher deposition of soil in the lakes as well.

Table 13. Ramsar sites in the Eastern Gobi Basins cluster

River basin	Ramsar site name	Aimag	Area, *km²*	Ramsar code
Galba-Uush-Doloodiin Govi	Lake Ganga and its surrounding wetlands	Sukhbaatar	32.8	

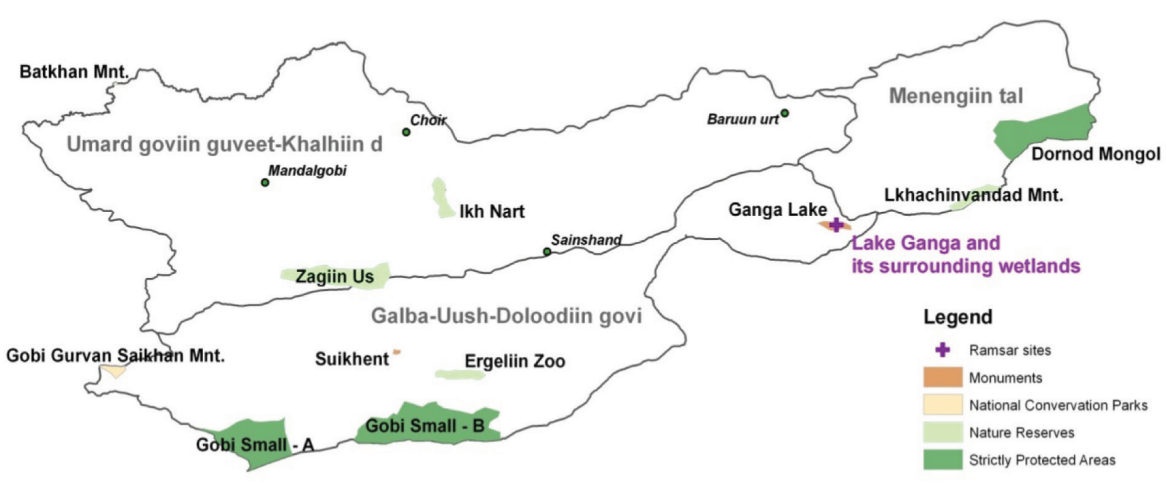

Figure 22. Zones under national protection status and RAMSAR sites in the Eastern Gobi basins cluster

Due to a reduction in number of working wells in the area, livestock tends to concentrate around the lakes to get water. More than 22,000 livestock is reported to be inside the Dariganga national park, surrounding Ganga Nuur. This exceeds by far the pasture capacity of the area. Many livestock graze around the lake, which are resulting in overgrazing of pasture land, as well as pollution the lake water by livestock. In summer livestock enters the shallow lake. Change of soil occurs here, because of the degradation of riparian vegetation and trampling. No bird survey has been carried out but disturbance of nesting sites has been observed.

Organic pollution is then expected to occur, and the lakes are very shallow and get easily warm (average temperature of 22 degrees in July-August for Ganga Nuur). They are very sensitive to eutrophication process. This risk is increased by the reduction of the lakes area. Impacts on riparian vegetation from livestock also reduce bird and fish habitats. Bacterial development could occur as well, leading to a possible impact on livestock health and productivity.

The management of the park need a staff reinforcement as only two rangers are reported to be in charge of the 62,820 ha wide national park, especially as inadequate transportation has been reported [37]. However some actions have been carried out, such as fencing and excluding the vicinity of lakes from livestock grazing in order to keep lake water free of pollution and organizing training and awareness among local residents. A total ban of pasture practices is not possible within the park area, as it is the major resource of income for local population. A better management of the pasture practices, by establishing capacity of areas, rotation of livestock and building or maintenance of wells in the buffer zones around the park would combine sustainability of the local economy and ecosystems.

5.4.5. Climate change

Precipitations slightly increased in the eastern Gobi region during the last 40 years. However year to year variability is high and reported to increase in this area, making the definition tricky. According to the latest climate simulations, temperature and surface run off are expected to increase. Spring snowmelt is expected to take place one to three weeks earlier than it does at present but consequences on eventual groundwater recharge or run off are difficult to evaluate.

As variability of precipitation will increase, number of surface water bodies may tremendously reduce some years, and will impact herders who often rely on surface water bodies for their livestock.

Moreover, increase of evaporation has small effect on these temporary streams, but will lower soil moisture and above all affect lakes levels. This will have a significant impact on the shallow lakes lying in these basins, reducing their area and volume, leading to a scarification of habitats for wild species, and increasing competition for water between wildlife and livestock.

5.5. Human activities linked to the aquatic ecosystems

5.5.1. Domestic uses

Density of population is low and concentrated mainly in aimag centers. Waste water treatment plants are reported to function, and they discharge the treated effluent in soil. However the Sainshand wastewater treatment plant may be in overcapacity. Little is known on the chemistry on the discharged effluent, and its possible transfer to ground water.

5.5.2. Agriculture and irrigated areas

The low availability for water, the high pH of the soil and the low density of population does not meet the requirement to establish extensive irrigated areas for crops. Irrigated agriculture is applied on a small scale with surface water from springs and stream flow during and after the rains. Small projects have been implemented to plant trees in order to reduce desertification but may have little effects due to the small areas that are concerned. Impact from agriculture does not represent an issue in these basins.

5.5.3. Pasture

Livestock species present in the basins reflect differences in pastureland capacity and species adaptability to the different land cover types. The desert steppe and desert environments provide most suitable habitat for camel, sheep and goats. Between 1990 and 2000, livestock numbers in Dornogovi, Dundgovi and Omnogovi aimags increased from 760,000 to 1,120,000 heads (47% increase). Similar to the national situation, the increase in livestock numbers corresponded with a change in livestock composition. The most dramatic shift occurred in goats and camels with the percentage of goats increasing from 30% in 1970 to 58% in 2004, and the percentage of camels decreasing from 18 to 6 % during the same period. Dry steppe pastureland in the northern part of the basins and along the Chinese border does provide suitable habitat for these livestock species [38].

However the lack of water wells is a major limiting factor to successful livestock production and livelihood sustainability. Many of the wells developed during the collective era no longer function because pump and water delivery systems have been destroyed or gravel filters used in deep wells no longer function. For instance, only 1,000 of the 1800 wells established in Dornogovi aimag, which has virtually no permanent surface water resources, were operable in 2003 [38]. In Dariganga national park which harbors specific and rare lake and wetland systems, pastureland is getting overgrazed in the vicinity of the RAMSAR sites due to lack of water points [32]. Competition is then increasing for water resource between wildlife species and livestock, gathering around surface water bodies.

Rehabilitation of wells would have a significant impact on the available pasture areas for herders. Kaczenki [39] established that if all traditional wells in the Dornogovi, Dundgovi, and Omnogovi aimag would be functioning, more than 53,000 km^2 of grazable pasture would be gained on the 56,000km^2 available with just springs and lakes as water resource for livestock. This would then improve livestock production and lower grazing pressure and water intake in the vicinity of the water bodies. The same situation is expected to occur in the three basins, as lack of maintenance for the wells is nationally widespread.

5.5.4. Industries and mining

Mining activities represent an important part of the basins economy. Big scale mining sites are implemented or planned in a near future in this region, creating issues about water resources and environmental conditions.

One of them is linked to the dewatering of the mining sites, creating a cone of depression that could lower the water table and affect deep-rooted plants such as saxaul and Siberian elm, in a radius of several kilometers around a mine, and will cause shallow wells and springs to dry up. Vegetation that depends on the surface water table may not survive, with resulting impacts on habitat, plant cover, and desertification. Herders may find themselves displaced from grazing land to places with a better water availability and competition for water that already takes place between wildlife and livestock is then expected to grow.

Where dewatering affects springs and wells, alternative water sources can be provided and/or other existing sources in the area can be enhanced and protected. The impacts of dewatering on trees should be monitored and mitigated through irrigation or by replanting and protection.

Gold and fluorspar illegal mining occurs in these basins though the number of miners reported in 2004 was low [40]. However the Zagiin us nature reserve (Dornogovi aimag) is suffering from a high potential stress from mining activities [31].

As reported by [32], the content of cyanide in water sample taken from Noyon soum of Umnogovi aimag, Galba-Uush-Doloodiin Govi river basin, surpassed the tolerable level by 12-15 times. By 2008 soil sample from land of Khanbogd soum, Umnogovi aimag had mercury content 3-370 times higher than the tolerable level. The content was higher by 5-27 times in samples from water points. The sites of contamination are most numerous in Omnogovi aimag [32] than in the other aimags.

Illegal mining is hard to control and patrolling might be time consuming and inefficient. Limiting the availability of mercury or cyanide in the region before it reaches markets could be a way to limit its use by ninja miners but is hard to enforce. Illegal trade has been reported to increase, with illegal import of mercury via China.

In some cases, specific training regarding the advantages of gravitational methods would help to change current practices and limit the use of heavy metals for gold recovery.

5.5.5. Forest management

The two tree species mainly found in this cluster, Siberian elm and saxaul depend on soil moisture content and are vulnerable to significant lowering of it [34].

Shrub forest, mainly composed of saxaul trees, only occupies a very small percentage of the total areas of the three basins. No study has been carried out on illegal forest use, but the nature of the forest itself (thin and scattered forested areas) is not suitable for commercial logging anyhow. Herders use saxaul trees as a cooking and heating fuel. Impact of livestock or woodcutting on shrubs would lead to a decrease of forested areas, hence aggravating land degradation. However the impact would not be significant on the hydrology of the basins.

5.5.6. Tourism

The Ramsar site Ganga Nuur is a tourist attraction given its closeness to the holy mountain of Bayan Ovoo, particularly during the festival of Naadam (early July). Problems may arise from pollution of the water, both by litter and detergent from the large number of people washing themselves, their clothes and their cars in the lake as reported; physical disturbances such as destruction of riparian vegetation or noise can significantly limit attractiveness of the site for migratory birds and wildlife. Moreover in recent years there has been an increase of visitors at Kholboo Nuur and other surrounding lakes to avoid the crowds around Ganga Nuur [36]. Even if the peak period of tourism (July-august) does not occur during the migratory period (starting in September), impact of tourism is an issue on this protected area, and no measures have been implemented to limit its adverse effects. Public awareness is needed and could be easily implemented as the area is already under a national protection status.

5.5.7. Fishing

Introduced Golden carp (*Carassius auratus gibelio*) in the region of the Ganga Nuur may have had a commercial interest. However, no reports mention any significant commercial fishing in the area. Locals may use fish as a food source in the vicinity of the lakes, but compared to the degradation of living conditions for fish (drying up of lakes and rivers, impact from livestock on the water bodies…) commercial or recreational fishing is not an issue in these basins.

5.5.8. Dams and flow regulation

No hydropower plants or dams are present or planned in these basins.

5.6. Summary of the ecological issues in the Eastern Gobi basins cluster

Surface water availability is temporary and is highly dependent on summer rainfall events. Variability of these events will increase in the near future due to climate changes and lead to some periods with very limited surface water availability and vegetation growth.

Reduction of functioning wells highly reduced the available grazing area and livestock concentrated around remaining water bodies. This generates impacts on these rare ecosystems and competition with wildlife for water. Rehabilitating wells could not only limit the competition with the livestock but would considerably increase the surface of pasture area, leading to a better potential for livestock production. However, increasing the number of wells should be accompanied by a better definition of the land capacity especially in buffer zones of protected areas.

According to available data, groundwater quality does not meet requirements for drinking water mainly due to high mineralization and sulfate concentration exceeding the norms.

The origin of these minerals is natural and treatment may be too costly to be implemented in rural areas, but mixing water from different sources to lower the concentration of minerals can be an effective solution in urban centers when possible.

Heavy metal pollutions have been detected, but the spatial distribution of polluted is area is not known. A spatial survey is needed to assess if pollution is restricted to a small area or if many sources of water are concerned. As these compounds can be transferred and easily accumulate in muscles and milk, there are risks concerning food safety and important loss for livestock production. The survey should be carried out with veterinary analysis to assess if signs of heavy metal exposure exist on livestock. It seems hard to limit the availability of heavy metals in ninjas` camps, as illegal trade is widespread. Specific training to replace use of mercury and arsenic by gravitational recovery methods is a solution to reduce heavy metal pollution.

Disturbances are increasing on the valuable Ganga Nuur site and its neighboring lakes which harbor rare bird species. Preservation of the site is needed to avoid a loss of attractiveness for wildlife and tourism. Public awareness is needed on this site as well as a better protection of the surroundings wetlands. Protection should not just occur during the migratory periods as degradation of habitats would have long term impact on nesting sites and food source.

Table 14. Main pressures in the Eastern Gobi basins cluster

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services
Climate change	Increasing evaporation	Changes in surface water flow and lake levels. Loss of soil moisture and land degradation.	Reduced water availability for human and livestock, especially for shallow lakes
Concentration of livestock in floodplains and around water bodies.	Overgrazing, increasing land degradation	Increasing land degradation Competition for water and disturbances for wildlife	Irreversible destruction of pasture areas. Source of infection for human health and livestock.
Mining activities	Dewatering around mining sites Use of heavy metals for illegal mining activities	Cone of depression created around mines will lower surface water table, possibly affecting springs. Pollution of aquifers	Loss of local wells will reduce usable pasture area Degradation of water quality, threats on food safety
Tourism	Increasing numbers of “eco-tourist” camps in the vicinity of water bodies	Disturbance to wildlife cycles, loss of symbolic wildlife species.	Loss of attractiveness and income from tourism in a near future

6. Gobi lakes valley cluster

6.1. The river basins

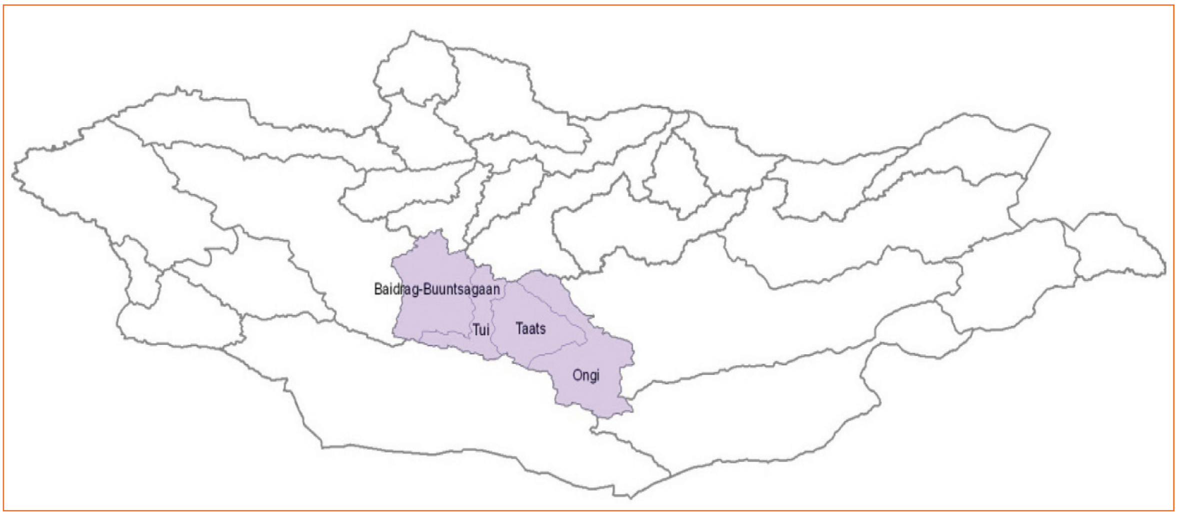

Figure 23. River basins of the Gobi lakes valley cluster

6.1.1. Geography

The valley of the Gobi lakes lies in the broad inter-mountain depression between the Khangai and Gobi-Altai mountains, at the foot of the Khara-Argalalntu ridge of the Gobi-Altai. The area is composed of composed of semi-desert, steppe desert and mountain semi-desert zones. Steppe and Mountain Forest Steppe cover much the slopes in the Khangai and Desert Steppe covers most of the lowlands.

Annual mean temperature is +20C - +60C but can vary from −160C in January to +200C in July. Average annual precipitation is 50 mm − 200 mm. There is a strong spatial variability however for precipitation. Most of the rainfall occurs in the north part of the basins, in the Khangai mountainous area. Precipitations in the south part of the basins, next to the Gobi-Altai mountain range, are very low. The area receives most rainfall in summer, the rain often being accompanied by very violent west and northwest winds.

In terms of climatic indicators, the historical climate records for the Bulgan soum show warming of approximately 0.7˚C over the period 1970 to 2002 [42].

6.1.2. Land cover

Pasture area covers more than 90% of the cluster (Table 15).

Tungalag [41] monitored and analyzed the land desertification processes in the Ongi River basin between 1998 and 2007. They showed that 12,000 square km of vegetation (nearly 30% of the river basin surface) has been lost during this period.

A recent study carried out on Bulgan soum, Ongi river basin [42] also showed a dramatic decrease of vegetation biomass. The mean vegetation biomass decreased from 100 kg/ha in 1991 to 58 kg/ha in 2005. Overall, 90% of the Bulgan Soum is subjected to land degradation, including 38% of the surface severely degraded (1990−2005). Runoff coefficient of the Ongi River (Uyanga station) has increased during period of 1980-1995. Reason of such change was mainly intensive forest cut in upstream basin in 1980-1987 [43].

Table 15. Gobi lake valley cluster land cover

River Basin	land cover (% of basin)							
	abandoned land	bare land	forest	Shrub forest	hay	pasture land	settlement	water
Ongi	0.1	2.6	0.5	3.2		93.3	0.3	
Taats	0.0	6.3	0.0	0.6		92.9		0.2
Tui	0.0	1.2	0.9	1.4	0.1	95.3	0.5	0.7
Baidrag-Buuntsagaan	0.4	1.4	0.6	0.1	0.5	96.1	0.0	0.8

Source: National Atlas - 2009

As the climatic and socio-economic conditions are similar in this group of basins, it can be expected that a loss of vegetation cover and biomass occurred on Taats, Tui and Baidrag-Buuntsagaan river basins as well.

Source: National Atlas - 2009

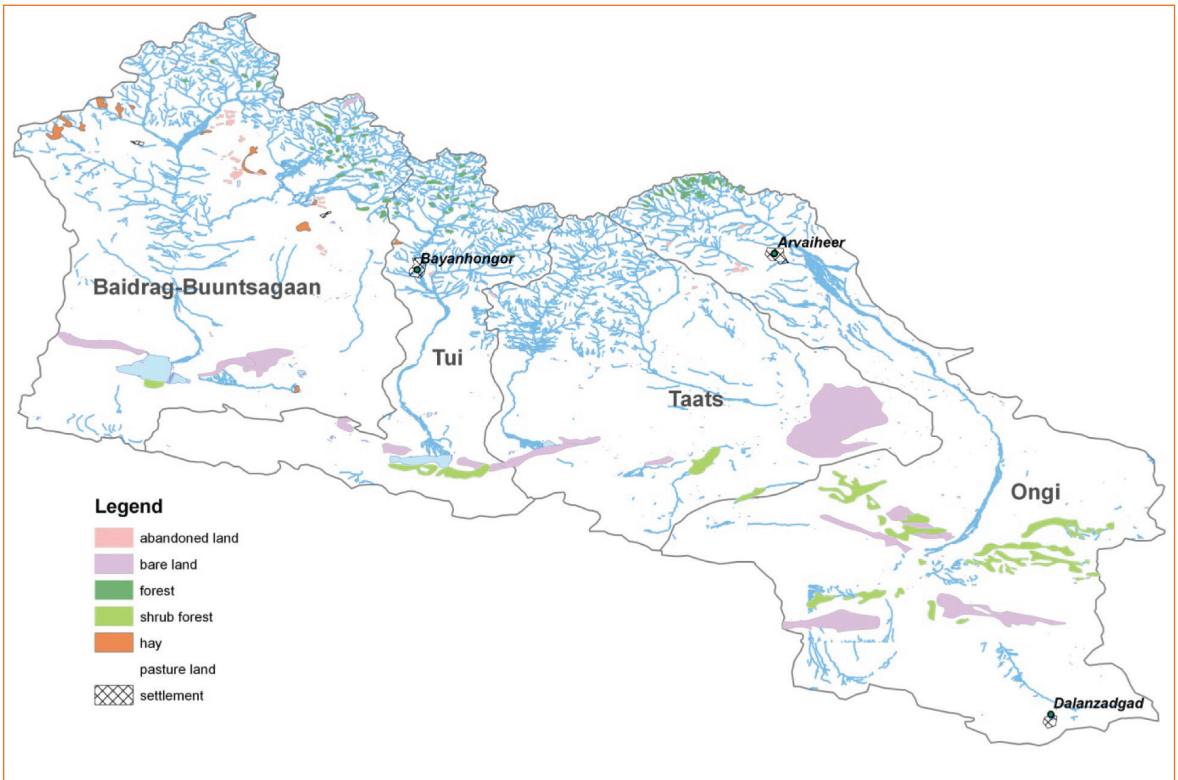

Figure 24. Land cover of the basin in the Gobi lakes valley cluster

According to these studies, degrading factors are multiple and desertification process complex. Vegetation cover is highly related to rainfall; even if temperature and precipitation seems to have remained the same during this period of time [41], the region is subject to considerable interannual fluctuations [42]. As even one rainfall event can make vegetation cover significantly increase, the importance of climate change is hard to assess with the absence of local data on a long period.

Increase of livestock (mainly goats) and concentration of livestock on certain areas and mining sites were found to be driving factors for land cover deterioration. Goats eat the widest range of food. Goats with sharp hooves cut through the cryptobiotic crust of fungi and other lower plants holding together the exposed soil in areas of sparse vegetation, thus making the soil susceptible to wind erosion [42]. It has been suggested that the recent severe spring dust storms might have been aggravated by the larger number of goats present across the Gobi region.

According to the common physical and socio-economic characteristics between Ongi basin and the rest of the basins in the Gobi lake valley, changes of structure in livestock composition and increasing number of mining sites might lead to similar land degradation in the other basins.

6.1.3. The river network

The basins of the Gobi lakes valley show a similar pattern of river network. Main inflow comes from rivers which rise in the Khangai Mountains in the north, and no permanent inflow comes from the Gobi-Altai in the south. Very few temporary tributaries come from the south part of the basin.

Table 16. Characteristics of the river networks in the basins in the Gobi lakes valley cluster

River Basin	Basin area, *km^2*	Main river length *,km*	Mean slope, *‰*	Mean basin elevation, *m*	Total length of river network *,km*	River network density *,km/km^2*
Tui	8403.7	243	0,010	2100	4461.2	0.53
Ongi	16027.6	435	0,0056	1650	5273.71	0.33
Baidrag-Buuntsagaan	18226	310	0.0068	2191	-	-
Taats	6700.5	200	0.0064	1760	1599.48	0.24

Source: IMH

The most important source of run-off for the Tui river basin is rainfall (46% of annual runoff) followed by groundwater (36%) and snow melting (16%). As the other basins present a similar topographic pattern, we can assume that the other basins of this region show the same run-off source distribution. Summer rainfall leads to a rapid increase of discharge in the rivers.

In the northern part of the basin, river network is quite dense due to the mountainous characteristics, where precipitations are the highest. However, as soon as the rivers exit the Khangai mountain range, there are just very little temporary tributaries flowing to the main rivers. A decrease of the discharge occurs between the upstream and the downstream part of the basin, for Ongi and Tui rivers. Water withdrawal from mining activities may have a significant impact, as water is stocked in reservoirs and favor evaporation. According to Mijiddorj, the drying up of the Ongi river is mainly attributable to the mining of gold placer deposit [45]. However other studies report that land degradation, or variability of precipitation and temperature are the main driving factors for the general decrease of run off reported in the last decades.

The rivers end up in the soil via infiltration or in closed lakes, the main ones being Boon Tsagaan Nuur (Baidrag basin), Orog Nuur (Tui basin), Tsagaan Nuur (Taats basin) and Ulaan Nuur (Ongi basin). They are mainly shallow lakes, with a saucershaped depth profile, and vary considerably size both seasonally and from year to year.

A gradual decrease of water levels in these lakes has been reported since 1978 [26]. Recent dry years began from and some biggest lakes located in the Gobi area such as Taats Nuur, Adgiin Tsagaan Nuur, Khaya Nuur, and Ulaan Nuur are permanently dry, and the Orog Nuur dried out in 2005-2007. Buuntsagaan Nuur, which was reported to be up to 15m deep in 1979, suffered from a dramatic decrease of more than 5 meters since 1999 [44]. Many other small temporary lakes lie in the basins, which are a valuable source of water for livestock, especially as many wells do not function anymore.

These wide and shallow lakes are very sensitive to evaporation. Recent increase of temperatures may be the main reasons for the drying up of lakes. As the decrease of water levels is reported to have start before the massive gold rush, mining activities are not the only source of pressure impacting water availability. A more detailed study would help us understand to what extent water withdrawal from mining activities affects surface water levels.

6.2. Surface water quality

6.2.1. Monitoring network

Few data were available on surface water quality in the Gobi lakes basins. Short term monitoring has been carried out on major ions and nutrients but do not reflect the expected high variability of water composition linked to the high variability of discharge in the basins.

6.2.2. Trends in surface water quality

The Tui, Taats and Ongi rivers show a light mineralization (ranging from 200 mg/l to 350 mg/l) and are included in the hydrocarbonate class and calcium group. On the other hand lakes show a high mineralization content (>2 g/l). Mineralization in the remaining lakes is expected to increase as water level drops.

Annual mean values for nutrients such as nitrate and phosphate are very low, the highest value being 0.458 mg/l of NO_3 and 0.032 mg/l PO_4 in the Taats river. However annual variability may be high and reinforced by the concentration of livestock and soil erosion by mining sites around water bodies, especially during summer during the flooding period collecting dung in the flood plain.

No data have been found on nutrient concentration in lakes, where the highest concentration may occur, due to the increasing livestock pressure on the shores. As concentration of phosphate in some other Mongolian lakes showed a significant increase in the past decade, the same situation may occur as well in the Gobi lakes. However this would have a much higher impact on the eutrophication process as lakes are much smaller and are more sensitive to slight changes in nutrient availability.

Pollution from mining activities has been reported in Shirhenii spring, Baidrag-Buuntsagaan basin, but concentrations of toxic elements are not available. A recent sampling campaign [46] showed that concentrations of heavy metals in surface water in the Gobi lake valley are below the permissible amounts, though soils contained significant quantities of lead and mercury.

6.3. Groundwater quality

6.3.1. Monitoring network

Data have been collected in the different Mongolian aimags for shallow and groundwater, from 1971 until 1990. Data for the aimags concerned are available for the major ions, pH, and a few analyses have been carried out on nitrogen-based molecules. Data on bacteriological analysis is scarce. A few recent studies focused on heavy metals concentration in soil and shallow aquifers, but the number of sampling stations is still too low to draw clear conclusions on the groundwater quality in the basins. As the region harbors activities using hazardous chemicals such as mercury for mining, monitoring of groundwater quality, especially for shallow wells, should be reinforced.

6.3.2. Trends in groundwater quality

Shallow and groundwater shows the same medium mineralization, with an average around 0.62 mg/l, HCO_3^- being the major ion. Water mineralization suits standards for human uses, though there can be a high variability. Concentration of nitrate, nitrite and ammonium shows that some of the shallow wells could be impacted by pollution, with concentration of nitrite and ammonium exceeding the standards on some location. However no clear spatial distribution can be drawn. Moreover practices, livestock composition, and pasture areas may have changed a lot since 1990.

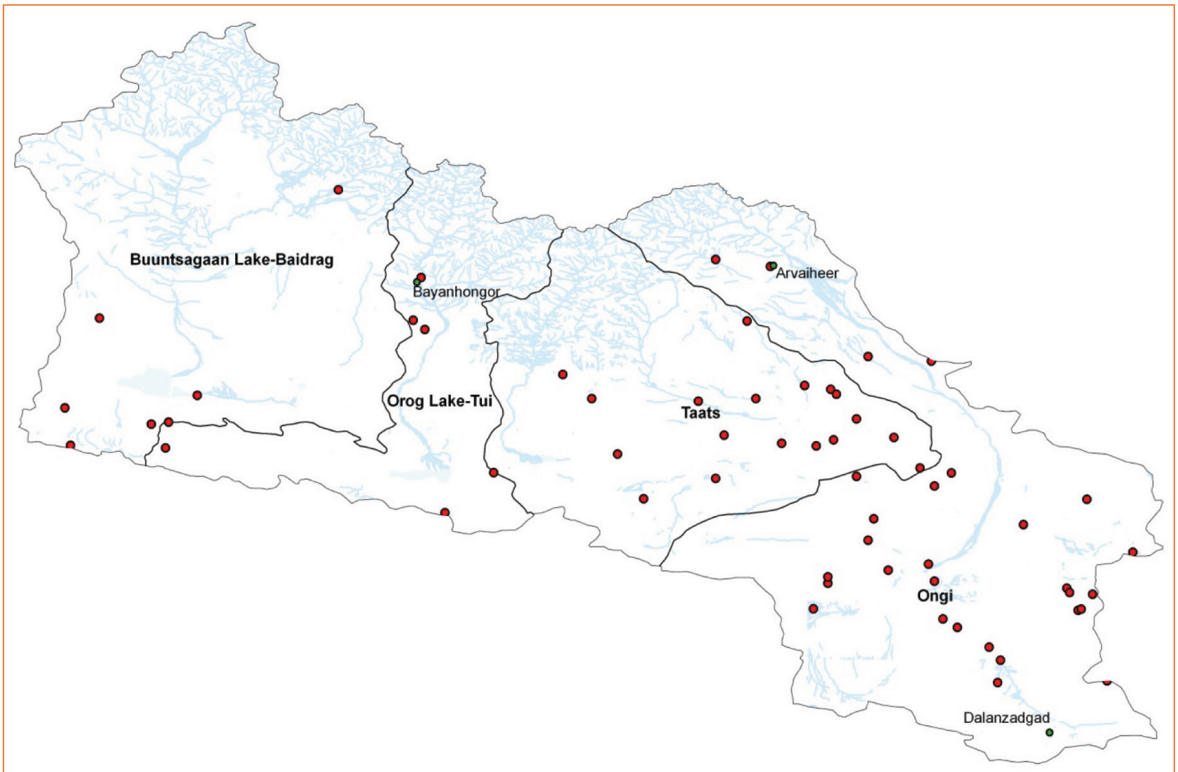

Figure 25. Location of the wells where mineralization exceeds 1000 mg/l in the Gobi lakes valley cluster

Recent data [46] did not reveale signs of heavy metal pollution in groundwater in Ongi river basin, whereas soil showed significant levels of mercury and copper. The high pH of the soil can limit heavy metals mobility and transfer to aquifers. However use of heavy metals is still recent and there are risks that other shallow wells become polluted in the future if these practices continue.

As the number of livestock reliable of groundwater increases, pollution of aquifer can become a threat for food safety, as heavy metals has a tendency to concentrate in fatty elements, such as meat and milk. This issue needs to be solved rapidly as contamination of shallow groundwater can go on for decades and strongly affect as well the economy based on livestock.

Several cases of bacterial contamination have been reported in water coming from shallow wells. In 2007, bacteriological analysis on 113 samples of water supply source in Dalanzadgad soum revealed that 10 % were not meeting the drinking water standards [47]. Very few water treatment plants exist in these basins. A better protection of water resources is needed, as contamination may surely be linked to the presence of livestock in the vicinity of the wells. Risk of contamination increases with the observed concentration of livestock in soum centers.

6.4. Ecological condition

6.4.1. Ecological monitoring

Few studies exist on ecology in these basins. Environmental description took place in 1998 to assess the ecological conditions of the region for its inscription as a RAMSAR site. Studies on fish population report different conclusions regarding fish species occurring in the basins.

An on-going project carried out by the Asia Center is to bring a survey including headwater streams, larger streams, major rivers, ponds, wetlands, glacial lakes, and lowland freshwater and saline lakes.

Studies on macro-invertebrates population and distribution are currently ongoing but the Mongolia Aquatic Insect Survey, but no data have been published yet.

6.4.2. Aquatic ecology

Various data sources do not report the same fish species in this cluster; according to the red list of fishes the endangered Gobi loach (*Barbatula dgebuadzei*) occurs in Baidrag river and vulnerable dwarf osman (*Oreoleuciscus humilis*) in the Ongi basin.

The RAMSAR site information sheet [46] adds the vulnerable Mongolian grayling specie in the Gobi Lake valley, and Bigmouth osman, and Lake Osman have been reported to occur in the basins as well.

No assessment on fish stock population in the lakes has been carried out. No fish species have been introduced in the lakes, though introduction of grass carp for commercial purpose has been proposed, as shallow water of these lakes is relatively warm and rich in aquatic macrophytes. Nowadays, as lake surfaces decreased and suitable habitats mostly disappeared, introduction of fish species should not be considered.

Drying up of rivers, decrease of lake levels and habitat degradation are reported to be the main causes of the loss of fish population. Mining activities, concentration of livestock and climate change are the main human threats reported for fish.

6.4.3. Terrestrial ecology

No amphibians listed as Threatened or Vulnerable according to the IUCN criteria are living in this group of basins. No data are available on amphibian species in the region.

Lakes of Gobi valley are known to be an important staging for migratory waterfowl, but few details are available. It has been suggested that they might be a breeding area for the rare Relict Gull. Orog Nuur is very important staging area for migratory waterfowl, particularly Anatidae and shorebirds, and supports breeding populations of a variety of species.

Taatsiin Tsagaan Nuur was formally an important stopover site for vulnerable species, such as Dalmatian Pelican and Palla`s Fish-eagle. The lake being currently dry, it may unfortunately not longer be considered as a migratory or nesting place for these species [29].

Drying up of lakes, loss of nesting habitats and reduction in number of fish will cause a major loss of migratory and shore birds. No survey is available though to assess quantitatively the decrease of bird population.

On a more general view, decrease of surface water availability triggers competition between wildlife and livestock to water access, as it is reported in the southern basins. Maintenance of existing wells would make new areas accessible for pasture, and lower the disturbances from livestock in the vicinity of surface water bodies which are necessary for wild life.

6.4.4. Zones with a specific ecological interest

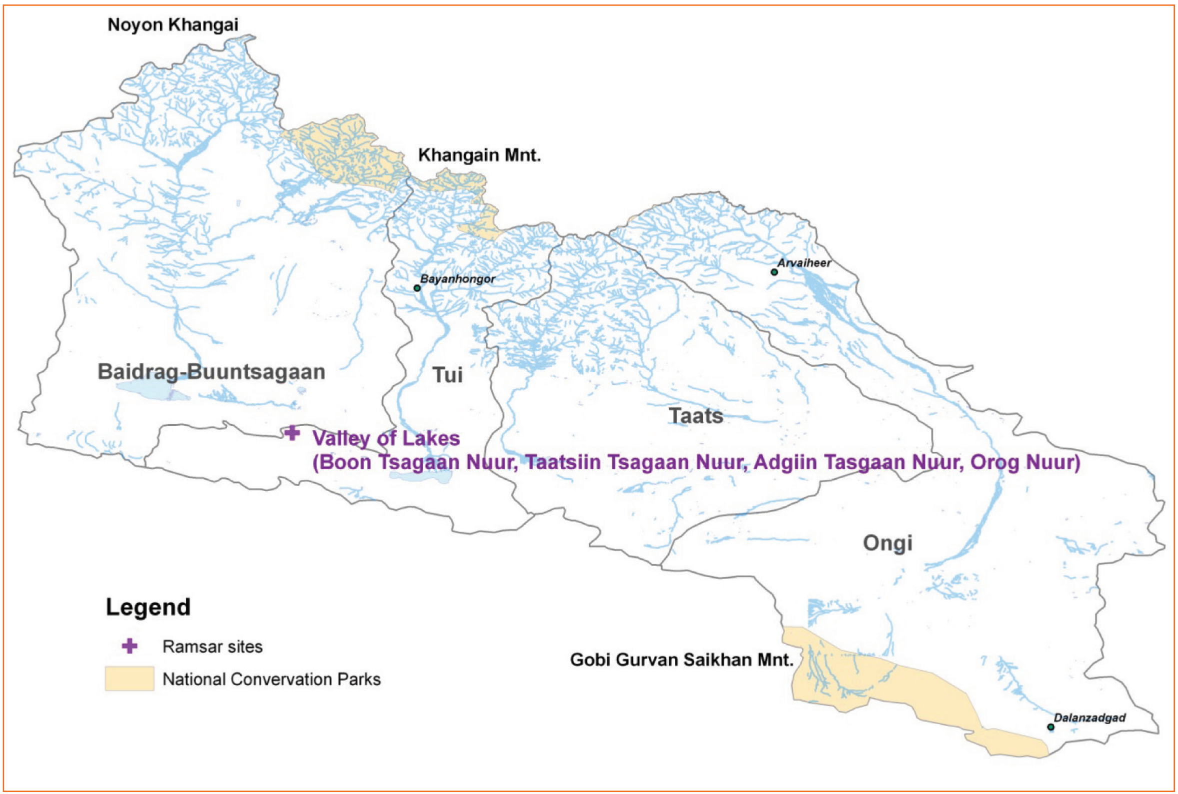

Figure 26. Zones under national protection status in the Gobi Lakes Valley cluster

The Gobi lake valley is covered by a RAMSAR site, including the lakes and their surrounding areas. The total surface of the RAMSAR site is 45 600Ha, representing almost 40% of the Gobi lakes valley. This site has been registered as a valuable wetland site in 1998 due to the specific habitats and being an important staging area for migratory waterfowl. No updates have been carried out yet on the RAMSAR status of this site.

The basins present a very little coverage of national protected areas. Only a small part of the Baidrag and Tui river basins, and the southern part of the Ongi river basins belong to a national protection park. Downstream parts of the Tui, Baidrag river, and Ongi river are under a local protection status, but little is known about the efficiency of environmental policies and control. Generally, protected areas are reported not to be efficient due mainly to a lack of training for local staff, as well as a lack of monitoring and patrolling.

6.4.5. Climate change

Survey in Bulgan soum reported that mean annual precipitation showed large interannual variability [42] which can make hard to assess a trend in precipitation due to climate change. In terms of climatic indicators, the historical climate records for the Bulgan soum show warming of approximately 0.7°C over the period 1970 to 2002 compare to 1.8°C for the national average.

The findings demonstrate frequent severe droughts but no long term shifts in the magnitude of precipitation. Baidrag and Ongi river basins may suffer from a reduction of run-off, or at least a slighter increase of run-off as expected in the other basins of Mongolia due to climate change.

Recent climate change has been reported to be the main cause of the drying up of lakes but this is hard to confirm as the lack of rainfall during the last decade may be due the result of the interannual variability of precipitation.

6.5. Human activities linked to the aquatic ecosystems

6.5.1. Domestic uses

There is no data to confirm impacts or not from domestic pollution, but population density and domestic uses of water is low and industrial activity in soum centers scarce or absent. Domestic pollution does not represent an issue in these basins compare to other anthropogenic impacts.

6.5.2. Agriculture and irrigated areas

Agriculture is very limited in these basins, principally based on irrigated areas from wells and springs in the vicinity of the center of the soums, which is reported to cause high water consumption and water loss [42]. Nutrient concentrations are very low in these rivers, which may be an indicator of very low fertilizer use.

6.5.3. Pasture

Pastoral and wildlife ecosystems pose challenging management problems associated with increasing livestock populations, rangeland degradation and alteration of pastoral migration patterns.

Because the number of water points continues to decline from year to year, traditional nomadic pastoral pattern of seasonal grazing have been disrupted with the loss of these watering points. The increased grazing pressure around the remaining water points have resulted in degradation of pasture area, which could be irreversible [49].

Due to economic and social constraints, the movements of the herders in southern Mongolia have been decreasing, causing overgrazing in winter settlements and near wells in many places [50].

The lack of water availability, caused by drying up of surface bodies as well as lack of maintenance of wells leads to a high concentration of livestock around few surface water bodies. For instance in Bulgan soum 30 % of herders in the Bulgan Soum water their animals in rivers. Degradation of riparian vegetation due to trampling and use a food source will increase river banks instability, leading to an increase of total suspended solids in water during summer floods. This concentration leads to a competition between wild animals living in the region such as large wild herbivores, including khulans, wild camels and gazelles.

In 2007, bacteriological analysis on 113 samples of water supply source in Dalanzadgad soum revealed that 10 % were not meeting the drinking water standards [47]. Source of contamination has not been clearly established but concentration of livestock around the aimag center may be the main cause of bacteriological pollution.

Control of grazing pressure in the vicinity of surface water bodies and maintenance of wells could help to dilute livestock pressure in the vicinity of water bodies and limit land degradation. Furthermore, as mentioned in chapter 6.3.2, there are risks of heavy metals contamination occurring in groundwater. Monitoring of groundwater quality should be carried out with veterinary analysis to assess if and how heavy metal transfer occurs to livestock.

6.5.4. Industries-mines

Registered mining activities occur in these basins, especially for gold exploitation. Many former mining sites have not been reclaimed and are known to host currently many informal gold miners.

Artisanal and small-scale mining is considered the main cause of degradation in water quality and aquatic habitats in the region. Studies report that construction of water reservoirs upstream of Ongi River have seriously influenced regime and resources of rivers and river water losses have increased significantly in recent years [43].

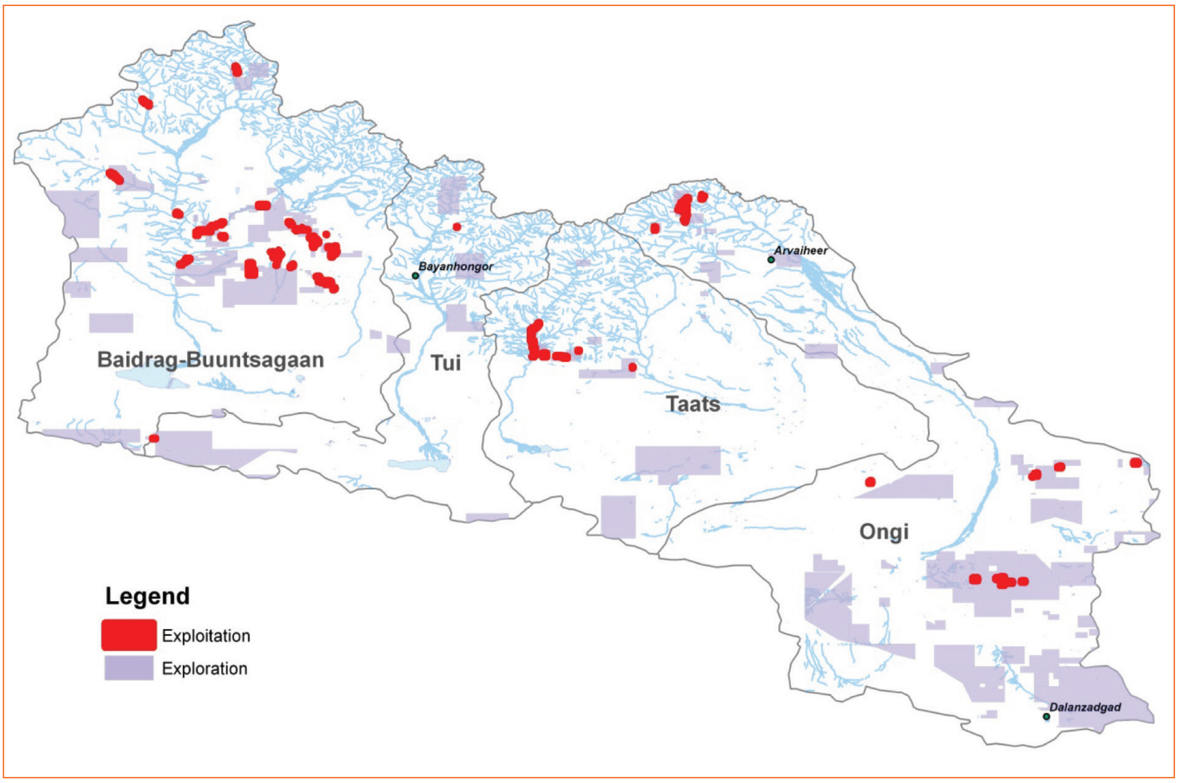

Figure 27. Mining exploration and exploitation in the Gobi Lakes Valley cluster

Bayankhongor and Ovorkhangai aimags, which cover the Baidrag-Buuntsagaan, Tui and Taats river basins, have been reported to host be the aimags hosting the bigger illegal gold mining activities, as nearly 10,000 informal gold miners have been estimated in each aimag [25].

According to Mijiddorj, the main reason of drying up Ongi river is due to the mining of gold placer deposit and never making technical and biological reclamation [51].

The impact of ninja miners on aquatic system is hard to define as they might be widespread and change location often. However, gross pollution of surface and underground water by uncontrolled burning of wood, dung, and rubber tires in order to melt the permafrost have been observed and have a direct impact on water quality [31].

Thousands of placer ninjas have been reported to use fire to melt the permafrost for their illegal mining activities. It prevents the spring thaw to get to the main river, and favor infiltration rather that run off reaching the rivers [31]. However the real impact of this practice on total run off is hard to assess and might concern only a few tributaries.

As ninja activities takes placer to the riverbank to pan in the river all-year-round, increase of the sediment load and turbidity is a major threat to aquatic habitats, leading to the clogging of spawning sites and destruction of riparian vegetation. As wood is often used as a fuel for permafrost melting, forest cutting has been intense, impacting moisture content in the soil and increasing desertification.

Illegal mercury and sulphate cyanide use is ubiquitous amongst artisanal hard-rock gold miners in Mongolia and has begun to spread to artisanal placer gold miners. A survey carried out in 2010 [46] revealed low of amounts of mercury in the surface water. All the samples revealed to be below the permissible amounts. Sediment samples and bryophytes were analyzed as well, not revealing any trace of mercury. However, the low number of samples (4 sediment samples and 3 bryophyte samples) in the area is not sufficient to draw conclusions on mercury contamination in sediments and plants in the area.

Toxic elements such as mercury are known to bioconcentrate in biological components such as plants and riparian vegetation. Livestock could suffer from chronic intake of mercury as their only food source is by grazing plants especially in the vicinity of water bodies. This could cause a loss of productivity from livestock and trigger health impacts to human population as the wide majority of the food source lies within the same area.

A detailed survey, assessing mercury and cyanide uses, its diffusion process to the biological components and the possible toxic impacts on aquatic species, livestock and local population is much needed in these basins.

The high concentration of illegal or legal gold mining in the vicinity of water bodies and processes used for gold extraction leads to a variety of direct and indirect impact of aquatic habitats. Mining does not just have impacts on morphology and biological habitats, but can rapidly decrease soil, surface and ground water quality. Many of the toxic elements used in the mining processes can easily be transferred and concentrate to biological components and livestock. Due to the widespread activities, the moving practices of the ninjas, and the lack of patrol and monitoring in the basins, these activities appears to be the major human threat for aquatic systems and their uses in the Ongi, Taats, Tui, and Baidrag-Buuntsagaan.

6.5.5. Forest management

The upstream part of the Baidrag, Taats and Ongi river basin are covered by scattered forest. Davaa assumed that intensive forest cut in upstream basin in the 1980s has been responsible of an increase of the surface run off coefficient in the upstream part of the basin between 1980 and 1995. The other basins may have been as much impacted by extensive forest use, as well as riparian vegetation. Wood is reported to be used by artisanal mining placers to melt permafrost, often through clear-cut of certain areas. Deforestation would contribute to land desertification and could increase water infiltration in the soil rather retaining soil moisture.

6.5.6. Tourism

No data is available on tourist activities in the region. Tourist related to the aquatic systems is expected to focus on recreational fishing and bird watching, but these basins are not subject to significant tourist activities.

6.5.7. Fishing

No commercial fishing is reported in the region. Baasanjav [52] reported that natives harvest fish by small amounts in Buuntsagaan Nuur.

However fish can be a valuable source of food and income especially in the vicinity of the lakes. Drying up of lakes, reduction in number of spawning sites, loss of habitats and possible heavy metal pollution can significantly decrease the fish stocks, hence depriving local population of valuable food source or income.

6.5.8. Dams and flow regulation

No hydropower plant is implemented or planned in these basins.

Construction of reservoirs upstream has been reported to stock water, especially for mining activities [43] Diversion of water impacts the rivers natural flow which is already low due to climate change. Loss of water through evaporation in these reservoirs has a high effect on natural river regime. The diversion of rivers for gold mining is reported to be the major reason for disappearance of Ulaan Nuur [42]. As similar practices are common in the 4 basins, major impacts of water diversion for mining activities can be expected as well.

6.6. Summary of the main pressures in the Gobi lakes valley cluster

Ecological conditions in the basins in the Gobi lake valley suffer principally from the drying up process of rivers and lakes. Lack of precipitation in the last decade may be due to the natural high variability of precipitations in the region, but human activities, mainly mining activities, play an important role in the drying up process with the withdrawal of significant amount of surface water and techniques (constructions of reservoirs) that favor evaporation. Furthermore downstream of the basins, the lakes are small and very shallow which make them very vulnerable to small changes in water regime. Water uses should be carefully monitored to assess the part of each activity in the drying up process of the lakes and rivers.

The loss of surface water availability and decrease of functioning wells tends to concentrate human activities such as herding in the vicinity of the remaining surface water bodies, increasing adverse impacts in these areas (see box in section 3.5.3), A reinforcement of sanitary protection of the water supply is needed as well as more and more animals gather in the vicinity of wells.

Table 17. Main pressures in the Gobi Lakes valley cluster

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services
Climate change	Increase evaporation Changes in precipitation pattern	Drying up of lakes and river	Decrease of water availability in shallow water bodies in some period of the year
Concentration of livestock in floodplains and around water bodies.	Overgrazing, increasing land degradation	Erosion and increase of turbidity in surface water. Loss of riparian vegetation as nesting place for birds	Impact on water quality Source of infection for human health and livestock.
Mining activities, especially illegal mining	Absence of land reclamation. Destabilization of river banks and riparian vegetation. Heavy metal pollution caused by gold recovery processes.	Modification of river regime caused by reservoirs. Loss of habitats for aquatic species and birds. Contamination of water and sediments by heavy metals	Loss of available pasture area due to lack of land reclamation Possible toxic effects on livestock due to heavy metals, leading to a productivity loss. Possible impact on human health.

Mining activities have strong impacts on surface water quality mainly regarding water turbidity and release of heavy metals such as arsenic and mercury used by illegal placer miners. Transfer of these heavy metals to biological components might eventually lead to adverse effects on livestock and human health. Monitoring campaigns are urgently needed regarding the dispersion of heavy metals to water bodies and food chain. Veterinary analysis on livestock should be carried out in the same time, as livestock can accumulate heavy metals and be a good indicator of the existence of pollution. Taking into account the mobility and remoteness of illegal mining activities, patrolling for illegal miners using heavy metals can be difficult and not effective. Limiting the availability of heavy metals on the market before they reach mining sites is difficult to enforce as well as illegal trade is already spread. Reinforcement of the ban of heavy metals uses should be accompanied by training of less impacting techniques as advantages of using mercury can often be eliminated by proper use of low-cost gravitational methods [31].

7. Eastern basins cluster

7.1. The river basins

Figure 28. River basins of the Eastern basins cluster

7.1.1. Geography

These basins lay in the eastern part of Mongolia, and are a part of the Amur basin, eventually flowing to the Pacific Ocean. They are surrounded by the Khentii mountain range to the west, with the highest point being the Asralt peak at 2.452m above sea level, small hills along the west side of the Kherlen river to the south, and the Dariganga basalt plateau and the Greater Hingaan mountains to the east of the Khalkh gol river basin. The basins are located in a tectonic depression dominated by plains and flat land east of the Khentii mountain range. This very flat steppe area harbors many small rivers, many of which are frequently dry, especially in the Kherlen river basins.

Mongolian eastern region has more humid climate compared to other regions and yearly total precipitation ranges from 250 to 400 mm. Southern parts of the eastern steppe yearly precipitation amounts up to 200 mm, in northern parts 300-350 mm and in Khentii Mountains 350-400 mm. More than 400 mm precipitation occurs only on the northern side of Khentii mountain, Ereen mountain range and Khyangan mountains.

About 90% of annual precipitation falls only in the warmer season. The first persistent snow cover falls in mid to late November and lasts for 101-134 days. Snow cover is only 1-21 cm, allowing for year-round livestock grazing.

The eastern steppe region is the most windy place in Mongolia and annual mean wind speed is over 3.0 m/s Nearly 75% of strong winds (over 15 m/s) are observed between April and August [53].

7.1.2. Land cover

These basins offer a wide variety of relief, landscape, and hence of land cover and land use. More than one third of the Onon basin area is covered by pine forest mainly located in its upstream part as well as in a small north east area of the Kherlen basin (Khentii Mountains).

Source: National Atlas - 2009

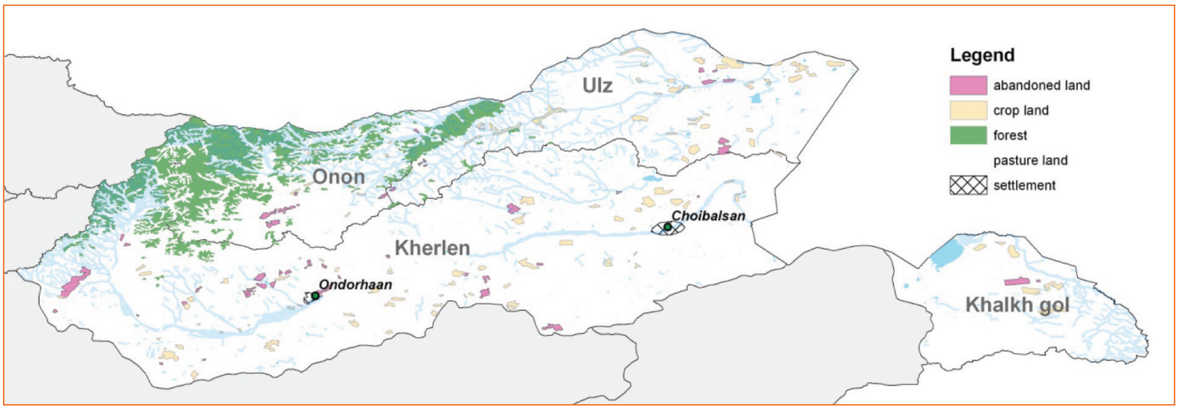

Figure 29. Land cover in the Eastern basins cluster

The rest of the basins are largely occupied by pasture land (nearly 90% of the land cover), lightly above the national average. Due to their topographical characteristics, Ulz and Khalk gol and the downstream part of Kherlen basin harbor a significant number of temporary of perennial lakes and wetlands.

Due to overgrazing, top soil structure has been lost in quite large areas within Onon River Basin (within about 5,000 hectares according to field work observations and unpublished research notes). For instance, some parts of farmland or cultivation land in Khurkh bag of Umnudelger soum have had sand and small pieces of gravel/rocks in their soils. It shows that the areas have been affected by wind erosion [53].

Table 18. Land cover in the Eastern basins cluster

River basin	land cover (% of basin)							
	abandoned land	bare land	crop land	forest	hay	pasture land	settlement	water
Onon	0.7	-	-	34.5	0.4	64.3	-	-
Ulz	0.6	0.4	2.5	1.4	1.1	93.5	-	0.6
Kherlen	0.8	0.1	0.5	3.5	1.0	93.4	0.6	0.2
Khalkh gol	0.0	0.2	0.3	0.3	0.1	98.8	0.2	0.1

Source: National Atlas - 2009

However, studies report that pasture in this region affect less intensively land degradation than in other parts of Mongolia. Of the total pastoral land in these basins, 12% is grazed at low intensity, 67% at moderate intensity, 18% is heavily overgrazed and three % of the pastoral land is severely overgrazed [54]. This can be explained by the lowest density of livestock in these basins, as eastern region has always had one of the lowest counts of livestock when compared to other regional averages. Numbers of livestock have been stable or slightly increasing across the eastern region between 1990 and 2005 [55], and are not expected to increase by a high percentage in the next decade, but as livestock concentrate in the floodplains and herders tends to reduce their migration pattern, land degradation could increase locally. Especially in summer, intensified grazing by an increasing number of animals (livestock) has been reported. Impacts of grazing include loss of topsoils, loss of riparian vegetation, and the erosion of large amounts of soil, silt and clay directly into the stream.

7.1.3. The river network

There is a strong contrast between the upstream part Kherlen basin lying in the Khentii mountain range, where bigger slopes and small torrents take place, and the rest of the basin which are mainly composed of flat steppe areas. Downstream of the Khentii mountain range, the Kherlen river has only very few tributaries, most of them being temporary. This river has the smallest river network density of all surface river basins in Mongolia, with just 0.1km river/km^2. There is even a slight decrease of run-off between its upstream and downstream part. The 23.5m^3/s mean discharge at Baganuur drops to 19.3 m^3/s at Choibalsan [55]. This participates to a loss of self-purification capacity between the upstream and the downstream part of the river. The Kherlen river ends up in the Dalai lake in China.

Table 19. River characteristics in the Eastern basins cluster

River Basin	Basin area, *km^2*	Main river length ,*km*	Mean slope, *‰*	Mean basin elevation, *m*	Total length of river network, *km*	River network density, *km/km^2*
Kherlen	107040	1213	0.0011	1071	11793	0.1
Onon	27998	570	0.003	1090	12755.9	0.46
Ulz	37391	496	0.001	720	19187.4	0.32
Khalkh gol	7440	264	0.003	720	26448.4	0.34

Source: IMH

Most of the run-off (64%) of Kherlen river is generated by rainfall, which occurs mainly during the summer period. According to the topography of the other basins, it can be expected that run-off source depends mainly of summer rainfall as well.

The Shud and Gal rivers do not reach the Kherlen River and are actually part of an endhoreic basin, flowing in the Yakhi Nuur.

The Onon river originates from south-east slope of the Khentei mountain. Among its total length of 808km, 298km goes through the territory of Mongolia. Onon river drains in to Ingedee river in Russian side and then goes to Amur river through Sjilka river in Russian. Inside Mongolia, the Onon river flows through forests and mountainous areas. One of the biggest tributaries is the Khumul river, flowing through Russia before entering the Mongolian territory. Due to the topography of the river basin, the Onon river has many temporary tributaries, principally generated by rainfall during summer.

Even if the Ulz river basin is considered to be part of the pacific ocean water basin, the Ulz river is actually a closed basin; it originates in Norovlin soum of Khentii aimag and drains into the brackish Torey Lakes complex, which a small part lies in Mongolia and the biggest part in Russia.

The Khalkh River originates from the western slopes of the Great Hinggan Mountains in China, and flows in a north/west direction, close to the border with China. The *Khalkh* river is a main tributary of the lake and is fed by 20% from underground water, 25% from snow melting, and 55% from rainfall [56]. About 30 kilometers before entering the Buir Nuur, the Khalkh River separates in two main branches, one of them being the Shariljiin River, flowing to China. Khalk river flow is hence divided before getting in Buir Nuur. The distribution of the flow between Khalk River and the Shariljiin River is assured by a little depositional island located in Mongolia, which topography is hence a determinant factor for Buir Nuur inflow and water levels. According to Gombo [57], field studies in this site carried out by various researchers indicate that blocking ability of the island is decreasing since 1960-th.

After an increase of the water levels between 1970 and 2000, Buir Nuur levels dramatically decreased by more than 160cm in the last 10 years [44] This study shows a high variability in water levels, suggesting that water level is very dependant of precipitation.

The Khalkh river inflows to the lake and Orshuun River flows out from it. Meanwhile, Sharilj River deviates from Khalkh River and drains to the Orshuun River in China, about 32 km before entering in Buir Nuur. Therefore, Sharilj river decreases inflow rate of Khalkh river and causes impacts to the lake. However, there is a depositional island or gravelkey, blocking outlet from Khalkh river to Sharilj river, in most upper stream of the Sharilj river.

Gombo underlines the importance of this little depositional island in upper stream of Sharilj river regarding water level and conservation of Buir Nuur ecosystem. According to him, a decrease of 1m on the height of the sediment deposit of this depositional island would result in a drop of 1.10m of the lake level. In correlation with change in water level of the lake, total dissolved solid content will increase. These changes in water regime and chemical composition could alter primary productivity and fish habitat in the lake. Impacts on lake water quality and biological productivity and the ecosystem are described below.

7.2. Surface water quality

7.2.1. Monitoring network

Hydrological network of the eastern Mongolia (Pacific Ocean Basin) consist of 9 gauging stations at Kherlen, Onon, Ulz, Khalkh gol rivers and Buir Nuur.

As in the rest of the country, the Asian found carry out a monitoring program on surface water chemistry and nutrients. Thirteen sampling sites have been monitored, eleven in the Onon river basin and one each in the upstream part of Ulz and Kherlen river basin.

Other studies are often based on one-time monitoring, mainly in summer period. The high variability of precipitation and water regime triggers significant changes in water chemistry composition and there is a lack of data in spring during the wash out process of the river banks.

7.2.2. Trends in surface water quality

As most of the rivers in Mongolia, bicarbonate and calcium are the dominant ions in surface water in the pacific drainage basin. The annual mean concentrations of total dissolved salts range from 117 mg/l for the Onon river basin up to 377 mg/l for the Ulz River. The Ulz River has the highest content in bicarbonate from all the Mongolian basins.

No general rising or falling trend in long-term basis in the rivers has been observed on surface water salts composition, expect on small areas of the Kherlen river; results of chemical analysis show some change of chemical composition between the upstream and the downstream part of Choibalsan in Kherlen river water. Hardness and mineralization have increased. This result indicates human impact on river water quality, but it is not clear if changes are due to domestic uses or by a higher concentration of livestock around the urban area. Choibalsan waste water treatment plant and increased erosion due to livestock trampling next to the streams could trigger higher mineralization.

According the Asian found monitoring data, the Onon, Ulz and Kherlen river present mostly a clean to very clean water index according to the water chemistry. Some of the samples revealed a slightly polluted water quality in 2007 but quality improved then in

2008. The average concentration of nitrate in these basins is 0.39 mg/l, with a maximum of 1.35 mg/l at the upper catchment of the Kherlen River [6]. Similar low concentrations are observed for phosphate, with concentration ranging from 0.01 to 0.024 mg/l. Nitrate concentration in the water was always very low, meaning that livestock grazing around the riverbanks may not be a pollution factor.

However, as dilution factor in these rivers is highly correlated to precipitations, concentrations have a high variability. Moreover samples have been taken in summer period. A monitoring should be carried out in spring time after snow melt of the first precipitation to assess the impact of the wash out of the soils at this period.

Water pollution transferred through Khumul river in Russia was recorded in Onon has been reported [54] but causes of pollution were not detailed.

Concentrations of nitrite and ammonium in the Kherlen River have been found to exceed the Mongolian standard. The norm of these two molecules in the Mongolian standard are very low compared to other countries, hence increasing drastically the chances to find samples above the norm. However these two molecules were not reported to be above the standards before. Increasing concentrations of nitrite and ammonium could be due to an increasing number of livestock in the vicinity of the water bodies.

Changes of chemical composition between the upstream and the downstream part of Choibalsan in Kherlen river water could be due to erosion due to livestock trampling next to the streams could trigger higher mineralization and increased concentration of nutrients in the streams, eventually increasing the eutrophication process in shallow lakes and wetlands downstream.

Concentration of TSS has been monitored in the Onon river over the period 1980-1990. Increased concentrations of TSS has been recorded at the end of 1980`s, mainly due to relatively increased runoff during these period than any other effect. There is a strong relationship between the discharge and the TSS concentrations. Unfortunately, no data is available on these sampling points after 1995. Impact from changes of livestock number, deforestation and increase of mining activities cannot be directly compared to the 1980-1990 period.

In tributaries of the Kherlen river however, data suggests that TSS is the downgrading factor for surface water quality. For instance amounts of suspended solids in the Terelj River (Kherlen river basin) have been recorded to range between 180 mg/l to 420 mg/l, (‘very polluted’ category of surface water standards in Mongolia). Highest amount have been recorded downstream of the mining sites.

However, resilience of pollution due to TSS in its spatial and time dimension is hard to assess. Self-purification capacity depends of many factors such as run off, morphology of the river bed, importance of the riparian vegetation, lateral connectivity, and intensity of river network...

7.3. Groundwater quality

7.3.1. Monitoring network

Data on composition for major ions, pH and sometime nutrients are available for deep and shallow wells in the basins. However the latest data available are from 1990. Concentration of nitrogen based molecules has been analyzed in some case, but are scarce and no clear conclusion can be drawn on the area regarding the lack of data. No significant set of data was available for bacteriological and heavy metal analysis.

7.3.2. Trends in groundwater quality

There is no separate groundwater quality standard in Mongolia. Water quality standards are used according the use of the groundwater, such as the drinking water standard, livestock watering standard or irrigation water standard.

Groundwater generally contains less minerals in the western part of these basins (Khentii aimag) than in the eastern part (Dornod aimag). Average mineralization range from 0.5 to 1 mg/l for groundwater, with HCO_3^- being by far the major ion and pH value ranging around 7 to 7,8. Water ion composition is generally suitable for human uses.

Concentration of nitrogen based molecules showed a high variability for shallow wells, though some curious values were observed in deep groundwater analysis as well (up to 30 mg/l NO3). We can not determine any mean value or spatial distribution from this dataset, however the occurrence of significant concentrations of nitrite, ammonium and nitrate shows that shallow aquifer can be easily polluted by livestock if proper protection of the resource is not implemented. The recent increase of livestock number and its concentration might have increase the occurrence of significant concentration of nitrogen based molecules in shallow aquifers.

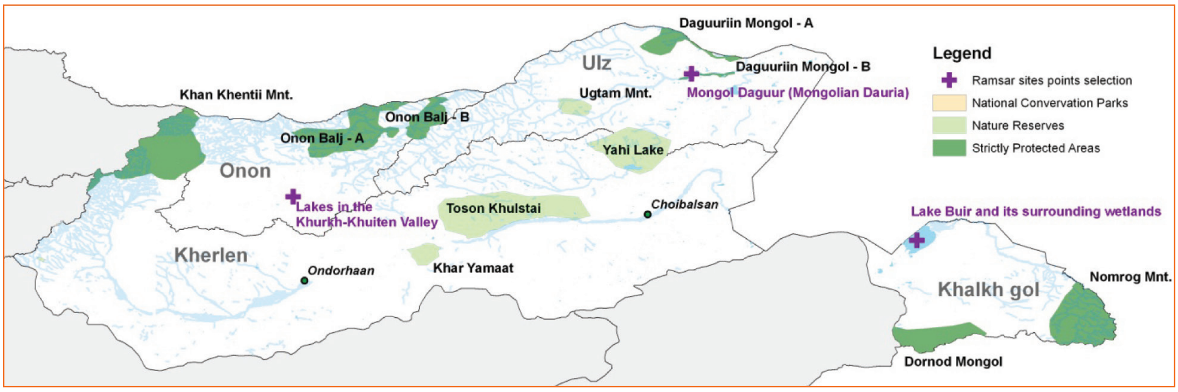

Figure 30. Location of the wells where mineralization exceeds 1000 mg/l in the Eastern basins cluster

As noticed in other basins, heavy metals can be transferred to shallow groundwater, though this is limited by the neutral-alkaline characteristic of soil and water. A survey should be carried out for groundwater quality in the Onon and the upstream part of Kherlen river basin where mining activities using heavy metal occur the most.

7.4. Ecological condition

7.4.1. Ecological monitoring

Monitoring of macroinvertebrate composition is carried out on the Onon river basin by the Asian foundation in for different streams in Onon River and one point in the upstream part of the Kherlen and Ulz river basins. Other studies focused mainly on symbolic and valuable recreational fish population like the Taimen.

It has to be noticed that Lenat's or Shannon's index may not be suitable to assess water quality in all Mongolian rivers, as they are more adapted to evaluate organic pollution than physical habitat degradation.

7.4.2. Aquatic ecology

Macroinvertebrates samples, which are a good indicator for habitat quality, revealed a poor biotic index in the Kherlen river at Baganuur sum downstream of the coal mining site, whereas water chemistry index showed a clear of very clear status. This poor biotic index is maybe the result of a release of fine particles from the mining sites upstream. Mainly Chironomidae, often associated with degraded or low biodiversity ecosystems, have been found. As macroinvetebrates index is less sensitive to changes in discharge conditions, it may be more reliable than the water quality index in these basins. Other biotic index in Onon, Ulz and Kherlen river basins were `excellent` in 2007.

The variety of conditions in these basins offers condition for a wide variety of fish. More than forty different species lies in the basin, which two of them are classified under an endangered status (Taimen and Amur Grayling) and one nearly threatened status (Amur spiny bitterling) according to the IUCN Red Book for fish.

The main concern in these basins for fish population is the degradation of their habitats. Causes are multiples; release of fine particles in the streams due to mining process is one of the major factors of degradation, as fine particles clogs spawning habitats of the salmonidaes such as the Taimen and the Amur Grayling. Deforestation has the same effect, particularly in the Onon river basin which has a bigger forest cover, hence more susceptible to forest cutting.

The Taimen is listed as Rare under the Mongolian Law on Fauna, although it remains possible to obtain fishing licenses for the species (Wingard and Odgerel, 2001) [16].

As Taimen have a late sexual maturity, catches of Taimen below 700mm impact heavily the population. As their sexual maturity starts at 6/7+ year old, population has a very low turn over.

Fishing has been reported as a cause of decrease of fishstock, especially for Taimen and Amur Grayling which are targeted by commercial and recreational fishing.

A recent study report that two invasive species, Amur goby Rhinogobius lindbergi and Chinese false Gudgeon Abbottina rivularis, have been found in Buir Nuur in 2008. Both species were previously known only from much farther downstream in the Amur River basin. These species have been found in three different sites, and with various size classes. This suggests that their colonization started some years ago and that they might be well established in the basin. Both species have been widely dispersed outside of the Amur River basin with other cyprinids introduced as commercially-cultivated fishes. This might be the most likely means of their introduction into Buir Nuur as well.

The long-term impacts of these species on the native ichthyofauna are unknown, but unlikely to be positive [58]. Other benthic fishes may be particularly impacted by competition with Amur goby and Chinese false gudgeon.

Shifts in reproductive timing, growth rates, and fecundity of gobies were observed [59] suggesting that the species is plastic and can rapidly adapt to local conditions. While this species has not yet been implicated in declines of native fishes, given its omnivorous diet (including fish eggs) and overall similarity to many of the endemic species of *Gobio* and *Microphysogobio*, the potential for negative impacts are considerable. Furthermore, mining activities and concentration of livestock near the river banks are known to favor sandy or silty substrates which are appropriate for the Amur goby. Even if these two invasive species have not been reported yet in Kherlen River, sampling sites were far from the Chinese border where introduction might have take place.

As there is usually no way to eliminate introduced populations of exotic fishes once established, a wide monitoring plan and a management is much needed to define the zones where invasive species occurs.

7.4.3. Terrestrial ecology

The Asiatic grass frog (*Rana chensinensis)* is included as Rare in the Mongolian red book of amphibians and has the `vulnerable` status in Mongolia according to the IUCN criterion. It is found inside the Khalk river basin. There is evidence of a population decline in Mongolia; habitat degradation constitutes a threat through wildfires (particularly in Ikh Hyangan Mountain Range), establishment of human settlements near water sources, and grazing by increasing numbers of livestock. This species congregates when hibernating, so entire populations can easily be destroyed. A program should be carried out to identify key areas for hibernation, to prevent disturbance or destruction of these habitats.

The Siberian Salamander *Salamandrella keyserlingi* is distributed along the Onon river in Khentii Mountain Range, the upper part of Kherlen River [10]. As the Asiatic grass frog, it is included as Rare in the Mongolian red book of amphibians and has the `vulnerable` status in Mongolia according to the IUCN criterion. The Siberian salamander is a unique amphibian in its freeze-tolerance: adults are able to survive freezing to -35 - -40 °C and can move at +0.5- +1.0 °C. The spawn can survive short-term freezing in the ice and frozen adults have been observed to revive after being found in permafrost of 4-14 meters in depth. Dominant threats are habitat degradation and loss, primarily caused by marsh drainage and water pollution.

Various species of migratory birds are reported to nest or live in these basins, especially in the eastern parts, where lakes and marshy areas offer them suitable habitats. For example, there are 240 bird species of 133 genera of 47 families of 18 orders recorded in Onon River Basin and it constitutes 50.8% of the birds recorded in Mongolia.

Endangered species not only nationwide but also worldwide e.g. Siberian crane *(Grus leucogeranus)*, white-naped crane *(Grus vipio)*, and great bustard *(Otis tarda)* are found these basins. Their main habitat is the riparian vegetation along rivers and lake shores. Concentration of livestock along riverbanks and domestic uses of riparian vegetation would then reduce habitats for these species.

7.4.4. Definition of zones with a specific ecological interest

Despite their great variety of landscapes, habitats, and natural species, the basins do not harbor a wide surface under a national protected status (11% of the basins).

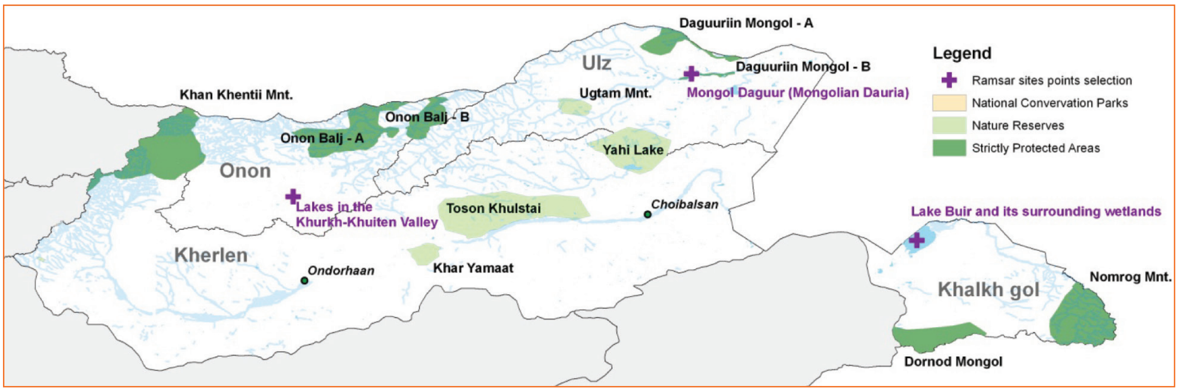

Figure 31. Zones under national protection status and RAMSAR sites in the Eastern basins cluster

Three Ramsar sites are located in the basins [60 61 62]. Located in the northeast part of the Ulz basin, Mongol Daguur RAMSAR site is composed of large wetlands. The larger northern part is composed of rolling steppes and wetlands on the south shore of the Tari Nuur, whereas the southern part encompasses a strip of the Udz River and its marshy wetlands with a high density of nesting whitenaped cranes. Five other species of cranes are regularly encountered in the area, including the threatened hooded and Siberian cranes. Out of the 226 bird species recorded, other endangered species include whooper swans, relict gull, mandarin duck and great bustard.

Table 20. RAMSAR sites in the Eastern Basin Cluster

River basin	Ramsar site name	Aimag	Area, *km²*	Ramsar code
Onon	Lakes in the Khurkh-Khuiten valley	Khentii	429	1380
Ulz	Mongol Daguur	Dornod	2100	924
Khalkh gol	Lake Buir and its surrounding wetlands	Dornod	1040	1377

The Mongol Daguur Strictly Protected Area overlaps some of this RAMSAR site as it covers the lower Ulz River basin with 90 small lakes, rivers, springs and wetlands. A total of 256 species of birds have been recorded there, which sixteen species of birds are included in the Mongolia Red Book. Grazing pressure is reported to be low in the strictly protected area but illegal hunting of rare birds, steppes fires and forest cutting threatens the ecosystem.

Lakes in the Khurkh-Khuiten valley RAMSAR site is situated in the transition zone between Mongolian forest and steppe zone, south west of the Onon basin. As tributaries of the Onon river, this complex of wetlands plays an important role in regulating water regimes. The wetlands harbor habitats of many threatened and endangered species from the southern forest taiga, central Asian steppe, and Western Asia and forest steppe of *Daguur-Manjuria*. The lakes and their surrounding wetlands are one of the important breeding and resting places for a great variety of water birds.

These lakes harbors fish species such as Haitej sculpin-*Mesocottus haitej* and Khadary whitefish-*Coregonus chadary* that could not be found from nowhere else from Mongolia [52]. Taimen Haitej sculpin Lamprey Eel-, River crayfiches, Molluscs, River mussels, Siberian Salamander, Asiatic Grass Frog-*Rana chensinensis* species are listed under Mongolian Red book are found from this area.

The Buir Nuur has a large portion of wetlands, and the RAMSAR site includes many small lakes located on the west of Buir Nuur. High mineralization and temperature makes it one of the most productive lakes in Mongolia, favoring a high diversity of fish, bird and mammals species. Main threats for wildlife are the loss of habitats due to intensive grazing, and the recent decrease of water levels in the lake.

Though they represent unique ecosystems, Lake Buir and the Lakes in the Khurkh-Khuiten river valley are not placed under a national protected status. In 2005, Dornod Province petitioned the central government of Mongolia to establish a nature reserve adjacent to Buir Lake on the border of the Mongolia-Manchuria grassland and the Daurian forest-steppe ecoregion [55]. Though the Buir Nuur area could not be placed under a strictly protected status due to the important economy based on commercial fishing and livestock, a proper protection status could be implemented in the adjacent lakes in the western part of the Buy Nuur RAMSAR site and for some lakes in the Khurkh-Khuiten river valley.

7.4.5. Climate change

All climate change studies indicate that temperature in Mongolia will rise in all seasons. The most recent studies suggest that in winter the rise will be more pronounced than the temperature rise in summer. Annual mean temperature of permafrost has increased in the Khentii mountainous region. Permafrost has a very important role for the hydrology of the rivers in these basins. Permafrost avoids infiltration and loss of water in soil during the snow melting process. Reduction of permafrost in the mountainous regions will reduce surface run off during spring time. Moreover a decrease of snow depths is observed in the northern Mongolian mountains. On changes in rainfall there is less agreement. Substantial differences occur between the projections from various climate model experiments. The already high variability of run off is expected to increase As the hydrological conditions of these rivers are heavily linked to rainfall, changes in pattern of precipitation will have a significant impact on the river regimes. Changes induced on discharge regime will have impacts on biological cycles, such as migration and spawning periods of fish. Higher variability of run off will favor species that can leave in a wide range of conditions, and might impact species with needs for specific habitats (e.g. salmonids)

Small lakes are often very shallow and hence very vulnerable to evaporation. The expected increase of temperature may lead to the dry up of many small water bodies, which have been already reported in some areas in the Ulz river basin [29]. This will increase mineralization of surface water and can lead to a decrease of water availability for livestock.

7.5. Human activities linked to the aquatic ecosystems

7.5.1. Domestic uses

Choibalsan wastewater treatment plant is outdated and does not have the capacity to treat all the effluents on the urban area. According to UNEP in Choibalsan City, Kherlen river receives approximately 1.83 million m^3/year of untreated wastewater. Changes in mineralization have been observed downstream of Choibalsan, but no data on a possible organic pollution has been reported. The purification rate of the sewage treatment plant was 44% as in 2004. Kherlen river does not have permanent tributaries downstream Choibalsan to dilute the untreated organic pollution. Impact on water quality for livestock downstream Choibalsan as well on fish migration from the Dalai lake in China to the Mongolian part of the Kherlen river can occur.

The density of population in the rest of the basin is low and industry is limited. No other signs of significant domestic pollution have been reported.

7.5.2. Agriculture and irrigated areas

Twelve % of the total crop land of Mongolia is located in the basins of the Kherlen, Onon, and Ulz Rivers. Eastern Mongolia produces 65-68 % of the hay for supplemental feeding of animals in Mongolia. Most of the hay meadows are located in Dornod aimag which accounts for more than 50 % of regional hay production. Neighboring Khentii aimag accounts for 30 % [55]. In previous years, up to 183,000 ha were used for cultivating crops in these 3 basins, which drop to 45% of this surface nowadays. More than 90% of the crop land is used for grain production. Soil in these basins is suitable for crops. As Mongolia aims to develop irrigated areas, it can be expected that crop surface in the Kherlen, Onon, and Ulz basin will increase in the next years [55]. As surface water network is not dense in the flat areas suitable for cropland, crop fields would tend to concentrate in the vicinity of the main rivers (e.g. Kherlen River).

Even if soil structure in this area is suitable for cropping, it is not very rich in nutrients and use of fertilizers could occur in the future to keep a good productivity. Even a slight increase of concentration of phosphorus could lead to accelerate the eutrophication process as these systems are phosphorus limited.

Irrigation by diversion of surface water in the Onon river basin has been reported Bayangol River in Binder soum, Shuus river and Khankhar natural spring in Bayan-adraga soum, and Buur natural spring in Dadal soum, but impact of river regime has not been established.

7.5.3. Pasture

Unlike the rest of the country, amount of livestock does not tend to increase significantly since 1990s. However there is a tendency to concentrate around sums centers. More than half of the population of the Onon, Ulz and Kherlen river basins (65%) is dependent on livestock [55]. In these 3 basins, only 30 to 63 % of pasture capacity is used, as water supply is a determining factor for the use and productivity of grazing lands. Therefore, pastures in the larger river valleys that are near streams, springs, lakes, ponds, and wells are intensively grazed almost year-round.

Availability for surface water is low in the Kherlen river basin. As very few tributaries reach the Kherlen river, livestock tends then to concentrate in the floodplain. This is reinforced by the lack of maintenance of wells, gathering herders in the vicinity of surface water.

7.5.4. Industries-mines

According to Simonov, more than 400 mining operations take place in the Mongolian part of the Amur river basin. No legal extraction has been reported in the Khalk gol river basin, however illegal mining could occur.

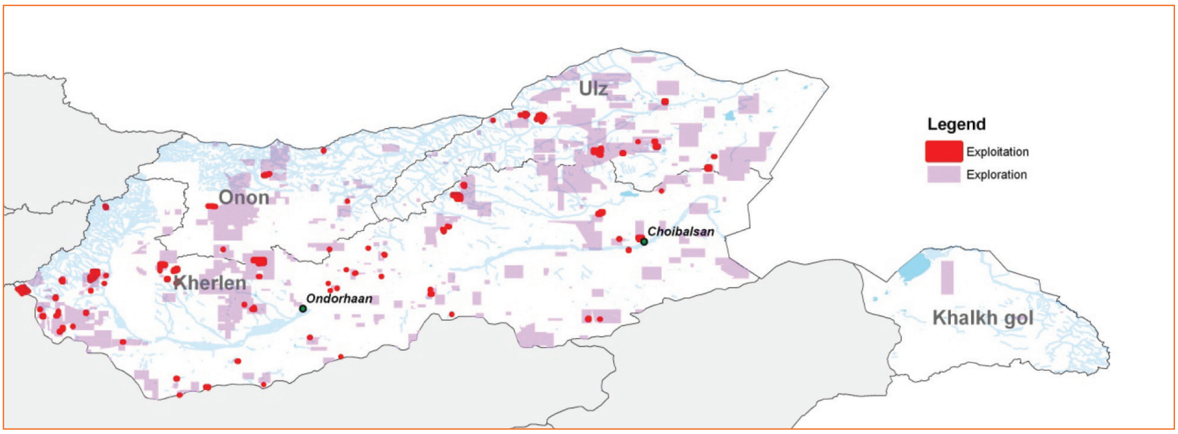

Figure 32. Mining sites in the Eastern basins cluster

Water for washing the ore is either pumped from wells, dammed off streams, or taken from the open pits. The water is discharged with the tailings into ponds, where most of it evaporates. As more water is removed than discharged back into the stream and groundwater system, the water table in the side valleys has declined and streams have been reported to dry up [25]. Moreover, mining activities takes often place in small tributaries, where ecosystems have a very high vulnerability.

Several important coal mining sites are located in these river basins. The Aduun Chuluun coal mine is located 6.5 km north of the town of Choibalsan in Dornod aimag. Groundwater is removed at a rate of approximately 3.5 million m^3 per year through wells located along the pits in order to lower the groundwater table to a level of about 20 meters below the bottom of the pits. These extend presently to an average depth of 70 meters below surface. With mining progressing toward the west, the depth of the pits will increase [31].

The state-owned Baganuur coal mine is located approximately 110 km east of Ulaanbaatar in Tov aimag, in the upstream part of the Kherlen river basin. It covers an area of 1,700 hectares, with an additional annual disturbance of 25 to 30 ha, and supplies 80% of the coal used by Ulaanbaatar's power plants. Processing of coal consists of crushing only; no washing is involved. In addition, to facilitate access to the mining area, the Khutsaa River (which was draining through a series of surface water bodies into Kherlen River) was diverted over a distance of 12 kilometers. Analysis carried by Asia Found in 2007, 2008 and 2009 downstream of the mining site reported clear or very clear surface water according to the Mongolian standards, with low turbidity. However macroinvertebrate index at the same sites was considered "poor".

Gold mining occurs as well in the Onon and Kherlen basin, principally upstream. Both legal and illegal mining activities are reported. As mining sites are located on the river banks, it triggers several direct impacts, depending on the process used to extract gold. Physical extraction is the most used. During mining operation, a release of fine particles takes place, increasing turbidity in water, and perturbing aquatic habitats, naturally gravel based, as stream bed get clogged. Destruction of riparian vegetation is reported as well, destabilizing rivers banks, decreasing natural habitats and limiting shadow cover. This can eventually lead to higher water temperature and reduce the amount of dissolved oxygen in the river.

It is not really clear if the use of heavy metal for the mining process occurs at a significant scale in the basins. In the vicinity of Tamsag bulag site, heavy metals are reported to have exceeded background amount, however no studies have been found to confirm this. However, it can be expected that like in the other parts of Mongolia, heavy metal is utilized, especially for illegal gold placer mine practices.

Little is known of the number of illegal mining sites. Mining pressure in Onon-Balj national conservation park, Ugtam nature reserve and Yakhi Lake nature are `medium`, whereas in other protected area inside the basins the mining pressure is considered as low [31].

As these basins are known to harbor a wide variety of ferrous minerals, an important part of the area is under exploration for mining activities, except for the Khalkh gol river basin. Extraction activities might then increase in the next years in all areas of the Kherlen, Ulz and Onon river basins; if the same polluting practices are employed in the future, we can expect a major impact on river morphology as well as on river quality. This will lead to a strong loss of ecological value as well as impact on tourist sector and livestock productivity.

Open mining have a strong impact on topography, as stripped zones and corresponding dumps of topsoil, waste rock, and tailings are often left behind without any mitigation after mining was terminated [25]. Potential pasture area is then reduced, as well as access to water for the livestock. This eventually leads to a higher concentration of livestock in other areas of the river basins, and increase land degradation process and impact on riparian vegetation.

Saulegul recently showed [63] significant higher concentration of suspended solids and slight variations in the pH, water temperature and conductivity of downstream mining sites compared to control sites in the upstream tributaries of the Kherlen river basin, where salmonids spawn. Macroinvertebrates populations were investigated as well and the highest abundances of macroinvertebrate in riffles and pools were found at the reference sites, with a strong decrease in total insect abundance at the mining sites, and directly downstream of the gold mining areas.

Open mining sites in Mongolia are known to increase the total phosphorus concentration in water as well [64]. As biological productivity in these basins is phosphorus-limited, even a slight increase of phosphorus concentrations in surface water will accelerate the eutrophication process, and decreasing concentration of dissolved oxygen favor the development of algae and impact water quality on a long stretch.

The Onon, Kherlen, and the Ulz river basin are impacted by both illegal and legal mining practices. Even if self-purification capacity is high in these basins, principally upstream, the growing number of mining sites has a strong impact on river morphology, water quality, and water availability. As the good environmental conditions bring a valuable resource to local population through livestock productivity and recreational fishing, a slight impact on the natural conditions could result in major economical loss in the basins. Release of fine particles of soil is the bigger factor of ecological degradation. Simple techniques such as better design and maintenance of settling ponds could improve significantly water quality and preserve habitats downstream of the mining sites. As in the rest of the country, lack of rehabilitation of land has been reported, which favors illegal mining on former mining sites. This increases the risk of development of invasive riparian plant species that can spread all along the river banks, leading to a loss of biodiversity and habitats. Land rehabilitation should be reinforced, using appropriate soil recover and local species for re-vegetation.

7.5.5. Forest Management

The Onon and the upstream part of the Kherlen river basins are widely covered by forests (more than one third of the basin). The forest is mainly composed of pine tree species. It is adapted to the harsh continental climate and resource limitations; hence rates of tree growth are slow.

Legal and illegal logging is a major economic activity in the basin especially in its western part, reinforced by the proximity with Ulaanbaatar which constitutes a big market for wood. The estimated levels of forest harvesting are unsustainable, being at least four times the sustainable [55].

Forest plays an important role in river discharge regulation. Water regulation role has 2 stages: first stage is catching of snow and precipitation, second stages is related to infiltrate and allocate ground surface water discharge. Changes in forest cover due to forest fires or clear-cutting significantly increase soil erosion during heavy rainfall. For example, in the Khentii region, surface water discharge is increased by 10-80 times in logged areas when snow melts compared to natural forest regions.

Deforestation leads to a release of small particles in rivers during rainfalls or snow-melt. This will result in a higher turbidity in the water and a change in stream bed particles size, leading to changes of macroinvertebrates composition and clogging of spawning sites will reduce the biodiversity in these basins. According to comparative research natural forest cover in a watershed of spawning river cannot be reduced below 50% without detrimental consequences for spawning salmonids, such as Lenok or Taimen [55]. Another impact is the accidental release of petrochemical compounds, used for logging, eventually reaching the water bodies.

Between 36 and 80 % of the total harvest in Mongolia is illegal, which make difficult a control and the implementation of sustainable practices. In order to protect the aquatic systems, patrolling and monitoring should be reinforce in the upstream tributaries or the Onon and Kherlen River, known to harbor the spawning sites of endangered and valuable species for the local economy.

Forest and step fires have been reported, especially in the northern and western part of the basins. Forest fires occur mostly in spring, and are caused by human activities, though unwillingly. Sparkles from exhaust pipes and chain saws can easily ignite a fire in dry periods. Numbers of forest fires and burned surface increased in the last decade, mainly due to the decrease of control in forest access and increase of illegal logging. Tools for monitoring and fighting against fires are also lacking.

Another threat to forest cover in Mongolia is forests pests. For instance, in Onon-Balj National Park in Khan Khentii Protected Area, infestations of Asian gypsy moth (*Lymantria dispar*) are causing severe damage [66]. Frequently, outbreaks coincide with periods when the trees are under stress. Warmer temperatures due to climate change may increase outbreaks frequency for some species [67].

As forest cover in these basins is important and plays a significant ecological role for the water bodies, a special attention should be put on pest damages in the Onon and upstream part of the Kherlen basins

Forest plays a critical role for ecological conditions of the water bodies, especially in the Onon and Kherlen river basins. These areas are widely used on an unsustainable rhythm.

Changes in forest cover will lead to changes in natural flow, increase the release of fine soil particles in the river, and affect water temperatures and water quality. Changes in river bed composition and water quality will affect natural habitats and biological components, including valuable species of fish for the local economy. On a large scale it might accelerate eutrophication process downstream.

It is therefore important to focus on illegal and legal forest use in the Onon river basin and the upstream part of the Kherlen river, as well as on pest control.

7.5.6. Tourism

Recreational fishing, especially linked to Taimen attractiveness, represents a valuable source of income in these basins for local population under the form of fishing licenses fees, local guides, and accommodation. Tourism is reported to have an impact on fish population, as more and more anglers come to these basins for the symbolic Taimen. Mongolia's Ministry of Nature has instituted catch-and-release, single-hook-barbless regulations for all Taimen fishing in Mongolia. Current fishing regulations list the spring ‘‘opening date’’ for Taimen fishing as 15 June, although regulations have not been consistently enforced, partially because Taimen spawn much earlier than 15 June in much of the country [68].

Provided that there is little or no catch-and-release fishing mortality [68], proper application of catch-and-release practices would combine preservation of the fish populations and income from tourism.

On Buir Nuur, lakes in the Khurkh-Khuiten and Mongol danuur, few tourists are coming for fishing or birdwatching, but this does not represent a pressure on the wetland ecosystems. Due to poor infrastructure, tourism is not expected to increase on these RAMSAR sites.

Bird-watching could become as well a valuable resource in these basins, as many worldwide rare species are known to nest or migrate in these areas.

7.5.7. Fishing

On one hand, fishing in streams targets principally the symbolic Taimen, for recreational purpose. This specie attracts a lot of tourists in the region, bringing valuable income to the soums (fishing fees) and local population (guides, accommodation...). The Taimen is listed as Rare under the Mongolian Law on Fauna, although it remains possible to obtain fishing licenses for the species.

No data have been found on the population trends for Taimen specifically on these river basins, but on the national level Taimen distribution has decreased by about 60% between 1985 and 2006 (i.e. just three generations of fish), suggesting a population decrease of 50% [13]. Moreover, according to the informal reports by local fishermen, Taimen with 100-160 cm lengths and 12-25 kg weights were caught several times from Onon river within Batshireet, Binder, Bayan-Adraga, and Dadal soums in 1990-2000, but very few Taimen with 50-110 cm body lengths and 2-7 kg weights were caught in 2005-2007.

Causes of this population trends are multiple, non-catch and release angling and capture of immature Taimen is one of them. As the apex predator in Siberian river ecosystems, the species is slow-growing, long-lived, and naturally resides at low population densities, thereby making the species highly vulnerable to overfishing.

Current measures taken to preserve Taimen stocks are the imposition of a minimal size at 70 cm, and ban on small mesh-sized nets. Fishing is normally banned on spawning grounds. However the level of implementation of the law is not known. National studies report that implementation of environmental laws is generally not efficient in Mongolia, hence we can expect that fishing can occur on spawning sites as well as during the ban period [26].

Better information from tour-operators and fishing camp along the Onon river about the number and the size of captured Taimen would provide a good database to evaluate Taimen population and distribution. Information campaigns about catch-and-release fishing for tourists are ongoing, but need to be reinforced. Taimen has a small area of occupancy (less than 500 km^2 based on spawning grounds [13]. Protection of these spawning sites is urgently needed in order to maintain a viable Taimen population.

In addition to tourists and visitors, local communities hunt Taimen in large amounts by using hooks and forks for household needs and do not provide any information on the fish they caught. It is then impossible to assess the part of loss due to recreational fishing due to tourism and local uses. This information is necessary to know where and how to carry out public awareness campaigns and reinforce patrolling. Actions have already been implemented in the Onon basin with training of local guides in order to apply sustainable fishing techniques. This type of action should be reinforced in the upstream part of the Kherlen river.

One the other hand, commercial fishing in lakes in these basins, especially Buir and Khukh lakes, has been exploited. In the past Buir Nuur, in the Pacific Ocean catchment, shared by Mongolia and China, had the highest fish production of all Mongolian lakes. Warm temperatures and a relatively high mineralization of the water explain the high biological productivity of the lake.

However, according to Dulmaa, due to overfishing of the lake as a whole, catches in the Mongolian sector have declined from an average of 537 t yr-1 in the late 1950s, to 40 t yr-1 in the 1996-98 period. Fishing pressure might have change between these two periods, but reduction of size of captured fish has been reported as well, indicating a drop of mature fish in the lake. Various studies reported different figures for catching productivity but they all agree on a decrease of catches and fish size in Buir Nuur. Caught fish in Buir Nuur are nowadays mainly exported to China [62].

Commercial fishing on Khukh Nuur has been developed later, starting from the 1990s. Catches are mainly exported to China as well. Buir Nuur is still intensively fished by the Chinese, especially during winter, when large nets are pulled by truck under ice cover [58].

Buir Nuur is a shallow lake and as a fragile equilibrium. Slight changes of water level and chemical composition can heavily affect primary production hence fish production. As mentioned by Gombo, the morphology of the Khalkh river right upstream of Buir

Nuur is significant as it regulates the flow between the inflow to Buir Nuur and the Sharilj river. According to Gombo, primary productivity could drop by 25 % and fish-harvesting rate decrease by 27% in the case of a 1m drop of the gravelkey. A suitable management of the water distribution between the downstream part of the Khalkh river and the Sharilj river is necessary to limit the decrease of water levels of Buir Nuur.

In Buir Nuur the endangered Amur pike is an important commercial fish. For the period 1974-1977 for the Mongolian sector of Buir Nuur pike represented 24 to 56% of the total catch with catches of 23.7 to 56.2 t/year, fished mostly by beach seines. Afterwards, catches of pike declined and during 1978-1990 they were between 13.5 and 33.1 t/year. Sampling in 2006 showed that Buir Nuur was devoid of large adult fishes, apparently as a result of severe over-fishing [69]. Captures control in Buir Nuur are however not easy to implement, as fishing in Buir Nuur became very conflicted and from both sides people frequently and freely violate the different laws and regulations on fishing.

The presence of invasive species such as Amur goby *Rhinogobius lindbergi* and Chinese false gudgeon *Abbottina rivularis* in the Buir Nuur drainage may have an impact on valuable fish stocks. Competition for food source, impact on eggs and hatching productivity may lower population of valuable fish for export, hence reducing income for local population. Amur goby and Chinese false Gudgeon could even settle in the upstream part of the rivers, taking advantage of changes of substrates due to mining and concentration of livestock near the river banks. This could possibly have effects on eggs or larval fishes of other species, including valuable recreational species such as Taimen especially if Amur goby would colonize the Kherlen river basin. Invasive species reported [58] can affect as well current fish composition and fish stocks in Buir Nuur, as they may include fish eggs in their food source. A more detailed monitoring of invasive species population as well as a study on their stomach content should be carried out, including other rivers flowing to China, such as the Kherlen river.

7.5.8. Dams and flow regulation

No hydropower plant is implemented or planned in these basins. A water transfer from Kherlen river to the south eastern part of Mongolia is projected. Water withdrawal will reduce the discharge and limit the dilution of pollutants and soil particles in the river. This will significantly reduce habitats as well and change the morphology of the river downstream. This water transfer might lead to the loss of floods which are beneficial for pasture areas in the flood plain, bringing precious nutrients and moisture to the soil. Changes of river natural regime and morphology should be carefully studied to assess impacts on pasture area and water availability downstream.

7.6. Summary of the main pressures in the Eastern basins cluster

The Onon, Kherlen, Ulz and Khalkh gol river basins present a wide variety of rare ecosystems, with strong differences between the western and the eastern parts of the region, due to geographic and climatic factors. Mining activities and forest management are the strongest issues in the Onon and the upstream part of the Kherlen river basins. Reinforcement of the existing environmental policies, especially rehabilitation of the former mining sites is needed in order to limit impacts to habitats and water quality. This region attracts more and more many tourist activities, especially for fishing. Fish species such as Taimen are very sensitive to loss of habitats linked to mining activities and forest use, and pressure from fishermen has a strong impact on the remaining population. If there is no changes of practices, Taimen population may disappear in the next decade. Monitoring of remaining population number and location is needed to implement better conversation rules, especially in spawning areas which became very scarce. Public awareness and promotion of catch-and-release techniques might help to limit the decrease of fish population.

Even if livestock number did not increase significantly in the last years in these basins, reduction of functioning wells triggered a higher concentration of livestock around the water bodies. Overgrazing can lead to irreversible land degradation, reduction of riparian vegetation, increasing turbidity in surface water and pollution of shallow groundwater. Maintenance of wells would limit the concentration of cattle in the vicinity of the streams and reduce land degradation.

Buir Nuur is an important ecological site and a source of revenues for activities such as commercial fishing and livestock. Massive drop of fish stock has been caused by overfishing in the last decade. Management of commercial fishing to maintain sustainable fish population could only be carried out with a transboundary agreement. Drop of water levels in the lake can be explained by recent climate change as well as local topography upstream of the lake, distributing the flow into the lake. Maintaining lake levels is necessary to avoid a greater loss of habitats than already caused by concentration of livestock around the lake. A protection status of the neighboring water bodies connected to Buir Nuur would preserve important habitats for fish and migratory birds with low impact to the economic activities on the area.

Table 21. Main pressures in the Eastern basins cluster

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services
Climate change	Increasing temperatures Reduction of snow depth	Changes in permafrost cover Changes of river regime	Decrease of water availability in shallow water bodies in some period of the year
Concentration of livestock in floodplains and around water bodies.	Overgrazing, increasing land degradation	Erosion and increase of turbidity in surface water. Destruction of riparian vegetation and aquatic habitats	Source of infection for human health and livestock.
Commercial fishing	Over fishing in Buir Nuur	Decrease of the fish stock Possible impact on bird food source.	Risk of non regeneration of fish stocks
Introduction of invasive species	Presence of new fish species with no commercial values detected in the Buir Nuur drainage.	Competition for food and habitats, destruction of endemic species eggs.	Impact on fish stock in Buir Nuur. Multiple potential impacts if such as colonization of the upstream parts of the basins.
Mining activities in the upstream part of Kherlen and Onon river basins	Release of fines particles in the stream Potential heavy metal pollution	Degradation of water quality Changes in macroinvertebrates population Changes in water chemistry composition Impacts on habitats, and more specially spawning sites for fish.	Loss of attractiveness for tourism linked to recreational fishing Loss of pasture areas due to lack of land reclamation Possible impacts on livestock productivity and food safety
Tourism	Non catch and release fishing of Taimen	Loss of Taimen population	Loss of attractiveness for tourism, and loss of income for local population
Forest fires, forest cutting and pests	Loss of forest cover in the Onon river basin and in the upstream part in the Kherlen basin	Changes in river regime, increasing erosion leading to higher turbidity in water. Possible increase of nutrient in water, leading to eutrophication	Impact on habitats for fish leading to a loss of valuable fish stocks.

8. Arctic Basins

8.1. The river basins

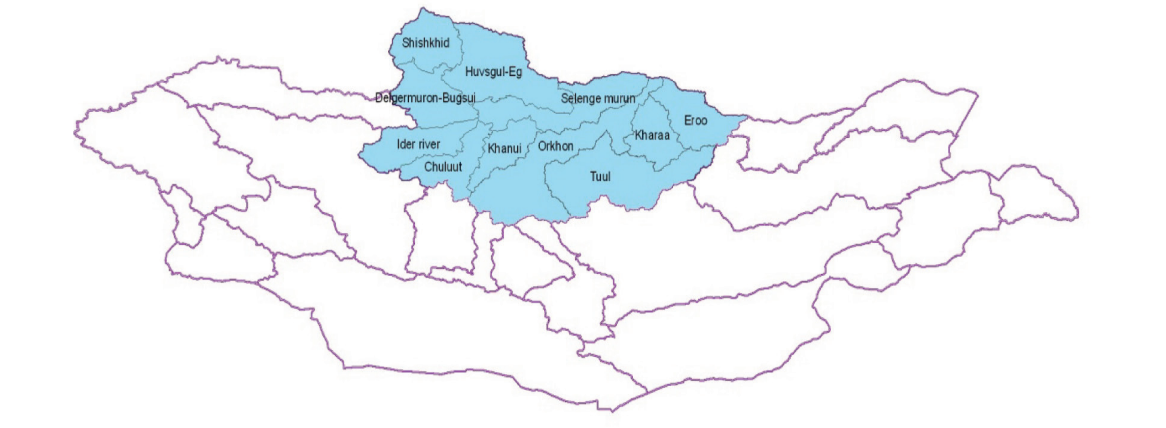

Figure 33. River basins of the Arctic basins cluster

8.2. Geography

The Mongolian Arctic Ocean basin is composed of the Selenge River, its tributaries, and the Shishkhid River which is not connected to the Selenge. It represents 20.6 % of territory of Mongolia. These rivers have a total length of 35,000 km (more than half of the total length of the rivers in Mongolia) including its all tributaries flow passing through in the 10 aimag's territory.

The Selenge catchment area is surrounded by the Khentii mountain range on the east, the Khangai mountain range on the south-west, and the Khovsgol mountain range on the north-west. The Shishkhid river basin, which is a part of the Arctic ocean drainage but does not flow into the Selenge in Mongolia, is lying in the Darkhan depression, west of the Khovsgol Lake.

The area belongs to the continental climate zone, which is characterized by wide variations of annual, monthly and diurnal temperatures, low range of air humidity, non uniform distribution of precipitation within a year, and cold and long lasting winters and warm summers. Permafrost cover is significant and plays an important role in water regulation.

Annual precipitation in the upper river reaches of the basin (Khangai, Khentii and Khuvsgul mountains) is 350-400 mm, while in the Orkhon, Selenge, and Kharaa River down stream valleys, annual precipitation is just 250-300 mm. Of the total annual precipitation, approximately 70% falls during the summer, typically in the form of thunderstorms.

The most important source of run-off for these rivers is rainfall, ranging from 40% (Kharaa River in Baruunkharaa) to almost 70% (Tuul River in Ulaanbaatar) of total run off. Due to the concentration of annual rainfall during summer months, analysis of average monthly discharges of the Selenge River indicates that about 50-70% of total annual discharge is concentrated in three summer months, and 20% is recorded in the spring. Due to intense and short precipitation, rivers in the Selenge River Basin experience mudflows and morphogenetic flooding.

These basins are heavily populated compare to the national average. More than 1.8 million resides in this area, representing 65% of the total Mongolian population in 2010. However population is unevenly distributed, as 74% of the basins population concentrated in the three biggest urban centers Ulaanbaatar (64%), Darkhan (4,3%) and Erdenet (4.7%), respectively on the shores of the Tuul, Kharaa and Khangal river (Orkhon basin). Excluding these urban centers, density in the basins drops to 1.5 inhabitants / km^2.

Main cities of the Selenge River Basin host almost all the big industries, hosting more than 80% of business establishments registered in Mongolia, hence water pollution from industrial activities can be a bigger issue than in any other basin. Most of industrial sites in urban area were developed during the last 30 years. Erdenet, Ulaanbaatar, and Darkhan hold main industrial infrastructure.

8.2.1. Land cover

The basins, located in the northern part of the country, are made up of taiga, high mountains, forest-steppe, and steppe zones. Due to the large expanse of the basin, the soil conditions and formation processes present differ greatly from region to region. Within the Khangai, Khentii, and Khuvsgul mountains, taiga, tundra, and mountain soil prevails, while in the wide valley areas of the Orkhon and Selenge Rivers, dry-steppe soil is dominant. Approximately 83% of the river basin landscape is classified as high mountain plateau and mountainous taiga, 87% is forest steppe and, 14% is steppe zone.

Source: National Atlas - 2009

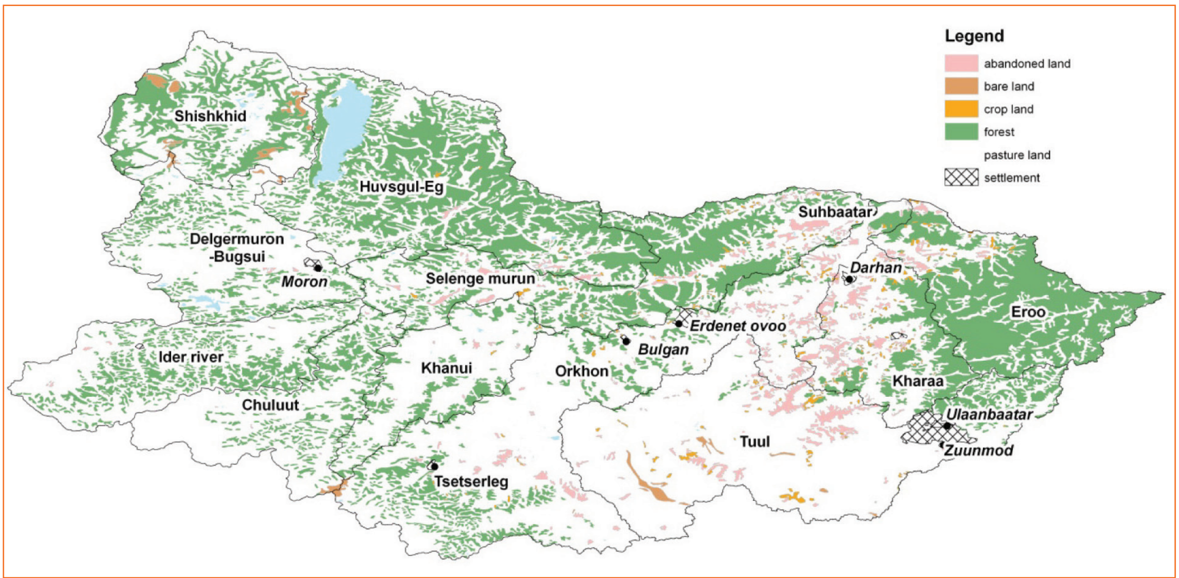

Figure 34. Land cover in the Arctic basins cluster

These river basins present a large percentage of forest cover compared to the national average (Figure 34 and Table 22). The forests are dominated by Siberian larch trees and birch trees. Forest cover has decreased in these basins, due to the demand and the proximity of cities like Ulaanbaatar, Darkhan and Erdenet (commercial logging), forest fire, and impact of forest pests. Causes and impacts due to deforestation are detailed below.

Table 22. Land cover in the Arctic basins cluster

River basin	Land cover (% of basin)						
	abandoned land	bare land	forest	hay land	pasture land	settlement	water
Selenge murun	3.9		41.5	1.0	53.5	0.0	0.0
Khuvsgul-Eg	0.6	0.0	50.3	0.2	42.1	0.0	6.8
Shishkhid	3.9		41.5	1.0	53.5	0.0	0.0
Delgermuron-Bugsui	0.2	0.4	19.9		77.8	0.6	1.0
Ider river	0.2		28.2		71.4	0.1	
Chuluut	0.1	0.5	20.0		79.1		0.3
Khanui	0.6		19.4	0.2	79.6	0.0	0.2
Orkhon-Tamir	3.2	0.2	15.1	0.7	80.0	0.8	0.1
Tuul	3.7	1.2	5.8	1.1	85.3	2.9	0.0
Kharaa-Shariin gol	9.3		25.8	2.6	61.0	1.3	
Eroo-Khuder-Minj	1.9		70.1	1.1	26.9		

Source: National Atlas - 2009

8.2.2. Organisation of the river network

The Selenge River, its tributaries, and the Shishkhid river basin harbor more than half of the total length of the rivers in Mongolia, with a total length of 35,000 km. The basins have a high density of river network. As expected, many temporary torrents flows from the mountainous areas while in the floodplain rivers are often large with braided channel morphology.

Table 23. River characteristics in the Arctic basins cluster

River Basin	Basin area, *km²*	Main river length, *km*	Mean slope, *%₀*	Mean basin elevation, *m*	Total length of river network, *km*	River network density, *km/km²*
Selenge	282154.1	1095	0.0019	1500	107692,8	0.38
Ider	22419.9	465	0.0047	1780	22230.3	0.99
Delgermurun	18670.6	439.7	0.0035	1921	8002.3	0.43
Eg	38354.1	509.5	0.0016	1624	13551.3	0.35
Orkhon	131105.6	1124	0.002	1300	85869.5	0.23
Tuul	48909.2	898	0.0015	1300	11046.5	0.23
Kharaa	14400	352	0.004	1272	5358.8	0.37
Eroo	10905.2	388	0.004	1320	5735.4	0.53
Shishkhid	19932.9	341	0.006	2200	11354.3	0.57

Source: IMH

The Shishkhid river basin lies in the Darkhad Depression, west of the lake Khovsgol, and does not belong to the Selenge basin drainage. The depression is about 150 km long and 40 km wide, and is surrounded by high forested mountains. Due to its topographical configuration, many lakes lies in the center of the depression.

The Selenge River is formed by the confluence of the Delgermurun and the Ider rivers, and originates from the Khangai mountain range. Its largest tributary is the Orkhon, originating from the Khangai as well and representing about 46% of the Selenge catchment area.

A detailed description of the Selenge River and its tributaries can be found in "Integrated Water Management Model on the Selenge River Basin Status Survey and Investigation Phase I".

Selenge River

The Selenge River was formed by the confluence of the Ider and Delgermurun rivers. The Ider River originates southeast of the Otgontenger, the highest peak of the Khangai Mountain range. Delgermurun and Ider rivers are upstream of Selenge River which has a total length of nearly 1000 km, out of which 600 km flows in Mongolian territory and catchment area of approximately 425,000 square km, where 66% lies in Mongolian territory.

Ider River

The Ider River originates in the Khangai Mountains. Its total length is 440 km and its catchment area is 26,896 km^2. The mean slope of the Ider River is 3.16% and its mean discharge is 65.1m^3/s. The Jargalant, Yamaat, Khar Chuluut, Chuluut, Bugtug, Khongor, Khuyagt, and Shumuult Rivers flow into the Ider River. The flow of the Ider River is 30% ground water, 25% snowmelt, and 45% rain water.

Delgermurun River

The Delgermurun River originates on the South slope of the Khuvsgul Mountains. Its total length is 391 km and its catchment area is 22,899 km^2. The Sharga, Agar, Burleg, Ikh Taras, and Beltes Rivers flow into the Delgermurun River. The flow of the Delgermurun River is 30% ground water, 17% snowmelt, and 53% rain water. The mean discharge of the Delgermurun River is 36.8 m^3/s.

Khanui River

The Khanui River originates in the Khangai Mountains. Its total length is 338 km and its catchment area is 14,890 km^2. Its mean slope is 3.35% and its mean discharge is 6.53 m^3/s at Erdenemandal hydrometrical station.

Eg River

The Eg River originates in Khuvsgul Lake, which is the freshest lake in Mongolia. Its total length is 453 km, and its catchment area is 41,799 km^2. The flow of the Eg River is 30% ground water, 17% snowmelt, and 53% rain water. Water discharge usually increases in May and decreases in June. In July, August, and occasionally in September the river is flooded several times. The mean of long-term discharge is 30.7m^3/s. The maximum discharge of the Eg River occurred in 1994 with 190 m^3/s, and 1995 with 118m^3/s.

The Khuvsgul lake holds nearly 70% of Mongolian freshwater. The lake is large, 136 km long and between 20-40 km wide, with a maximum depth of 262 m. Its residence time is 162.6 years. Ninety-six rivers and streams drain into the Khuvsgul but only the Eg river drains from the lake. It is considered as an ultraoligotrophic lake, which means it has very low concentration of nutrients and a very low biological productivity. Water levels increased by nearly 100 cm from 1966.

Orkhon River

The Orkhon River originates on the South slope of the Suvarga Khairkhan Mountain. The Orkhon River flows into the Selenge River. Its total length is 922 km and its catchment area is 130,425 km^2. Around Kharkhorin (Uvurkhangai), the river consists of 37% ground water, 16% snowmelt, and 47% rain water. Around Orkhon (Bulgan), the river consists of 39% ground water, 11% snowmelt, and 50% rain water. Around Sukhbaatar (Selenge), the river consists of 36% ground water, 18% snowmelt, and 46% rain water.

Tuul River

The source of Tuul River starts at the Nergui River, which originates at Shoroot Mountain. Its total length is 728 km, and its drainage area is 49,453 km^2. The average annual discharge and average specific discharge for Ulaanbaatar are calculated at 28.41 m^3/s and 4.51 $1/s/km^2$, respectively (JICA, 1995). The discharge reaches a peak in July or August, and the flood discharges are recorded in these two months.

Kharaa River

The Kharaa River begins at the Bayan River. The Bayan River originates at Khentii Mountain. Its catchment area is 14,400 km^2, and its length is 267 km. Its mean slope is 2.32%, and its average width is between 15 and 20m. The flow comes from 43% ground water, 15% snowmelt, and 42% rain water. The mean discharge is 15.4m^3/s and maximum discharge of the Kharaa River occurred in 1971 with 23.3 m^3/s and 1973 with 22.9m^3/s.

Eroo River

The source of Eroo River starts at the crossing of the Yostii and Chuluut Rivers. Those two rivers originate at the Asralt Kharkhan (2,800m) and Gelen (2,551m) Mountains. Its total length is 221 km and its catchment area is 11,000 km^2. The flow consists of 43% ground water, 15% snowmelt, and 42% rain water. The mean discharge is 49.8 m^3/s and the maximum discharge of the Eroo River occurred in 1973 with 115.9 m^3/s and 1985, with 112.6m^3/s.

8.3. Surface water quality

8.3.1. Monitoring network

Monitoring of major ions in surface water has been carried out since 1949 in some rivers (e.g. Muren and Orkhon river). Monitoring of toxic substances such as heavy metal is much more recent, and only occurs in some river basins affected by human activities.

The MoMo project is carrying out monthly monitoring of surface water chemistry on 4 points of the Kharaa valley since august 2007. They underline the lack of laboratories able to determine concentrations of toxic substances such as heavy metals.

Several one or two time monitoring studies have been carried out, mainly focusing on effects on mining activities.

Monitoring of surface water focused as well on the impact of wastewater treatment plants in Darkhan, Erdenet and Ulaanbaatar, but often failed to assess the distance on which water quality is degraded (self-purification capacity) and its variation during the year due to a lack of monitoring points. The same remark can be applied on impacts from mining activities. As Mongolian rivers have a high variability of self-purification capacity in time and space, the same pollution or pressure on the ecosystem can affect a variable distance of rivers and have different effects on biological compartments. It is then important to know what basins and parts of the rivers are more vulnerable to define priority of actions.

Asian found carried out several years monitoring program on surface water but data are currently not accessible. Sampling on representative points of the river basins is necessary to determine trends, and should be completed by biological monitoring (e.g. macroinvertebrates and fish population).

8.3.2. Trends in surface water quality

The surface water in the Selenge river and its tributaries is soft, with mineralization ranging from 100 to 250 mg/l, calcium and bicarbonate being the dominant ions. Even if mineralization is low, rivers of the Arctic drainage basin have a higher concentration of ions than rivers in the Pacific Ocean basin and the closed Asian basin.

Rivers flowing from the Khentii and the Khangai mountain range have a lower mineralization than rivers flowing from the Bulnai and the southern slope of the Khuvsgul Lake. This is due to the abundance of limestone and granite at Khuvsgul Lake, plus the important forest cover giving more solubles.

Due to the low level of mineralization, surface water does not often meet the lower limits for $Ca^{2+}$and Mg^{2+} for drinking water. The seasonal variation of surface water chemistry is marked, with highest concentration of HCO_3^-, Ca^{2+} and Mg^{2+} observed at the end of winter before decreasing and reaching the lowest value in July or August. SO_4^{2-} and Cl concentration are extremely variable as well through the year but does not show a clear seasonal pattern.

Long term observation (1949-1990) did not show general trends in ion composition in these basins. Recent changes have been observed in some stretches, due to anthropogenic impacts. The major change is the increasing content of fine particles in surface water. Changes are more pronounced in tributaries, where the dilution capacity is lower. A recent increasing in sulphate concentration has been observed in the lower reach of the Orkhon River.

Bacteriological contamination is a concern as surface water is often used for dinking without treatment. Analysis carried out in 2006 reported no bacteriological contamination in the Selenge river catchment. However due to the high density of streams and the mobility of livestock, the more frequent cause of bacterial contamination, it is not possible to have a good monitoring of sanitary issues regarding surface water quality.

Concentration of ammonium and nitrite were reported to exceed the standards in Kharaa valley and in the Orkhon, but other studies at a different period revealed that concentrations of these elements were below the standards. As many studies are just a one time monitoring and concentrations show a high variability linked to discharge condition, it is hard to determine a trend for ammonium and nitrite.

Heavy metals pollution is a raising problem, with concentrations of mercury, arsenic, and exceeding the norms for surface water in some points. Significant concentrations of mercury in surface water have been found especially in the mid and down reaches of Kharaa basin and its tributaries, Eroo basin, Tuul downstream of Zaamar mining site. Heavy metals, especially mercury, have a very low solubility in water. Heavy metals often stick to soil particles and are transported downstream during floods. Hence, heavy metal concentration can show a great temporal and spatial variability in surface water, and a one-time analysis can not represent the actual level of pollution. Analysis of sediments and biotic compartments (aquatic vegetation, macroinvertebrates, and fish tissues) can be more relevant as they represent the long term exposition to heavy metals. Furthermore it would help to understand the capacity of heavy metal to be transferred from surface water and sediments to biological components.

Highest concentrations of heavy metals have been found in the basins where legal and illegal mining occur. According to the Integrated Water Management Model on the Selenge River Basin survey, the Tuul river basin had the highest level of disturbance due to gold mining activities. However there is still a lack of general monitoring to determine hot spots of pollution and zones that are still untouched.

An increase of sulphate concentration has been observed downstream of the Orkhon river. Sulphates are often due to agricultural activities and use of fertilizer, and may come from crops on the right bank of the Orkhon valley. Furthermore Erdenet copper mine releases high content of sulphate in its waste water in Khangal River, a tributary of the Orkhon.

The resilience of the pollution in its spatial dimension is a key to assess the impact to the aquatic environment, but few studies assess the capacity of self-purification of Mongolian rivers. The same activities can have different degree of impact depending on the receiving water body,

8.4. Groundwater quality

8.4.1. Monitoring network

Data are available for major ions, pH and sometimes nitrogen based molecules in some deep and shallow wells in the area. Data available for this report have been recorded from 1971 until 1990. The small number of analysis on nitrogen based molecules does not allow us to establish clear conclusions on the whole area, though. Changes of groundwater quality that can occur for shallow wells can not be determined with this set of data. Data from bacteriological analysis are scare.

8.4.2. Trends in groundwater quality

Groundwater ion composition is generally suitable for human uses in these basins. Average mineralization is around 0.5 mg/l, mainly composed of HCO_3^- and Cl ions, with pH value ranging from 7.3 to 8. Nitrogen based molecules concentration shows a much higher variability; with concentration of nitrite and ammonium sometimes exceeding standards. No clear trend in time or spatial dimension can be observed with the data available, but it shows that shallow groundwater can easily be polluted, probably from livestock.

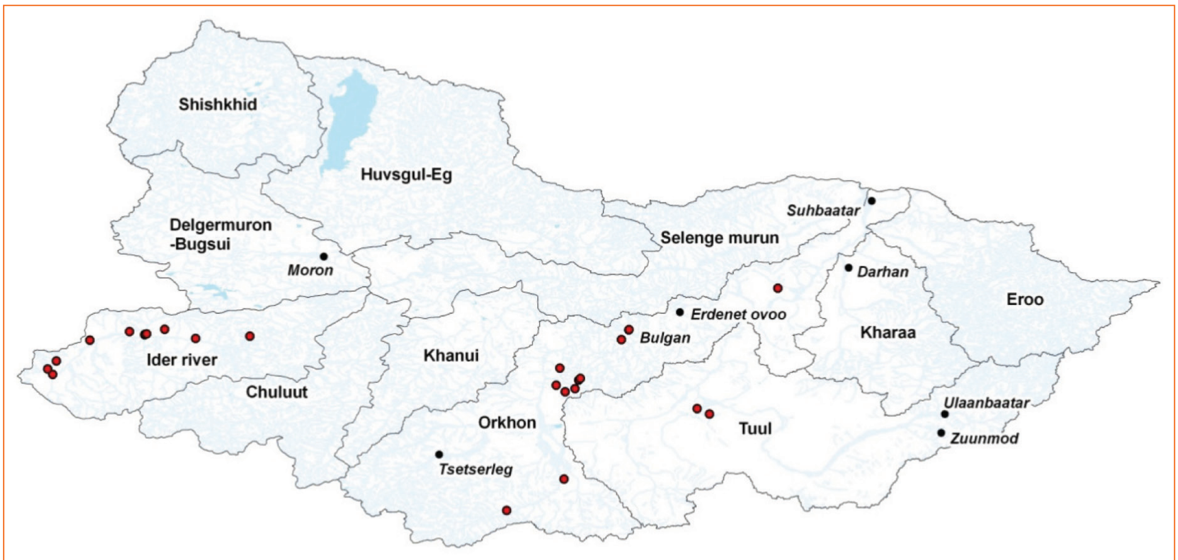

Figure 35. Location of wells where mineralization exceeds 1000 mg/l in the Arctic basins cluster

Recent studies showed significant amount of arsenic, mercury, and cyanide in shallow groundwater [71]. Pollution was reported in Kharaa river basin but below drinkable water standards. However use of heavy metals is still recent and there are risks that other shallow wells become polluted in the future if these practices continue. As the number of livestock reliable of groundwater increases, pollution of aquifer can become a threat for food safety, as heavy metals has a tendency to concentrate in fatty elements, such as meat and milk. This issue needs to be solved rapidly in basins that are known to support illegal of heavy metals, as Kharaa and Eroo river basins. Contamination of shallow groundwater can go on for decades and strongly affect as well the economy based on livestock.

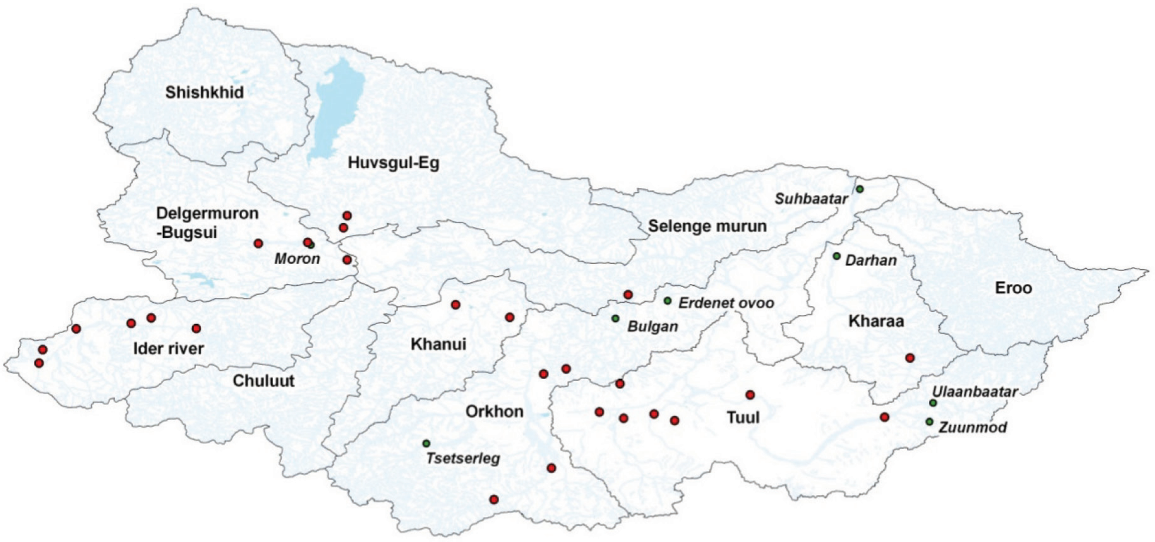

Figure 36. Location of wells where sulphate concentration exceeds 400 mg/l in the Arctic basins cluster

Recent bacteriological survey showed no signs of contamination but the number of sampling points was not significant to draw a clear conclusion in the whole area. Concentration of livestock around remaining wells and soum centers has increase the risk of contamination. This can be a threat to human health as groundwater is not often treated in rural areas.

8.5. Ecological condition

8.5.1. Ecological monitoring

There has been several recent studies monitoring and analyzing the biological compartments, mostly in basins impacted by anthropogenic activities. Surveys on biological compartments, such as macro-invertebrates and fish are recent, making it hard to establish comparisons on biological conditions before and after the increase of human activities from the 1990s.

Moreover, a specific macroinvertebrate index should be created to take into account the specificity of Mongolian streams and type of impacts. Macroinvertebrates indexes used are better to represent effects of organic pollution, which is not the biggest issue in Mongolia. The Mongolian Aquatic Insect Survey research project is currently trying to build up a biotic index and to document aquatic macroinvertebrate diversity and relate that diversity to patterns in evolution, ecology and water quality in Mongolia.

The most documented issue in the basins is the impact of mining activities on biological compartment and habitats. Long term studies on the changes of habitats (riparian vegetation, sediment balance, hydromorphology...) are lacking.

8.5.2. Aquatic ecology

The Mongolian Arctic ocean drainage harbors many endangered species of fish, more than any other group of basins in Mongolia-check. Among them is the critically endangered Siberian sturgeon *Acipenser baerii*. This is the only fish species under this status in Mongolia. It is distributed in Mongolia in Selenge and Orkhon rivers, and the lower reach of Kharaa River. According to the red book of fish, the overall area of occupancy is less than 10 km^2 with three spawning identified (two in Selenge and one in the Orkhon River).

The Mongolian red book of fish includes overfishing as the major threat and impact by urban pollution and mining activities. Increase of turbidity in the Selenge due to deforestation impacts its habitat as well. As it reaches its sexual maturity late (between the ages of 18-24 for males and 24-28 for females), renewal of population is very low. Fishing of the Siberian sturgeon is ban according to the Mongolian law but its implementation has been reported to be not effective.

Other endangered species are the Arctic whitefish (*Coregonus pidschian*), present in Darkhad Depression and Uur and Eg rivers. Main threat for this species is the competition and hybridization with *Coregonus peled*, introduced for commercial purpose from 1978 onwards. The Khovsgol grayling, present in lake Khovsgol and associated rivers is threatened by overfishing and loss of spawning sites.

The Taimen is a symbolic fish species in the Arctic ocean drainage. Population has been reported to significantly decrease in the last decade. Taimen distribution has decreased by about 60% since 1985 (21 years or three generations), suggesting a population decrease of 50%. It is suspected that the population will decrease by over 60% in the next 20 years as demand increases from China and Russia and from non-catch and release angling. The species has an area of occupancy of less than 500 km^2 based on spawning grounds, and occurs at fewer than five locations based on the threat of illegal fishing. Furthermore, studies have suggested that mature Taimen may spawn only once every 2–3 years [72]

Asian common carp and East Asian catfish were introduced to the Baikal basin in 1960. Distribution of this fish species becoming wider and observed in river Tuul, Orkhon and Ugii Lake. These species are now well implemented and it seems than equilibrium has been reached with endemic species.

Kraetz [73] reported the importance of run-off for the Arctic Grayling population in the Kharaa river. Many salmonids have a narrow range of suitable conditions to achieve their biological cycles. Even a small change in water regime or size of the bed particles can significantly impact current fish population especially as they have a late sexual maturity. Most of the fish species in the basins are then very sensitive to small changes of hydrological conditions and habitat availability.

8.5.3. Terrestrial ecology

Two species of amphibians, the Siberian salamander *Salamandrella keyserlingii* and the Far Eastern tree frog or Japanese tree frog *Hyla japonica* are enlisted as Vulnerable in the IUCN classification. Dominant threats are habitat degradation, primarily caused by marsh drainage and mining and logging activities, as well as water pollution. Increase of dry conditions may have an impact as well on these populations.

Kuzmin [74] showed a significant drop of amphibian population in the Orkhon river basin, affecting Siberian salamander and Japanese tree frog, due to overall drying of landscape leads to drying of wetlands suitable for amphibian reproduction and early development. Intensive cattle breeding and artificial drying of wetlands for agriculture purpose overlapping with climate dynamics threaten amphibian populations and floodplain habitats.

Future development of irrigated areas in the basins might increase the loss of suitable habitats for these vulnerable species. In order to limit the division of remaining population, biological corridors should be implemented in areas most affected by land use changes.

8.5.4. Definition of zones with a specific ecological interest

Compared to the national average, strictly protected area cover is low in these basins, covering less than 7% of the total area, including the area of lake Khovsgol as well. Downstream parts of the rivers are not represented in the strictly protected areas, but are often under a local protected status.

Figure 37. Zones under national protection status and RAMSAR sites in the Arctic basins cluster

The different types of ecosystems are not equally represented, with the majority of the area with protected status outside lake Khovsgol consisting of alpine tundra.

Main threats to the protection of the areas are forest fire, harvest of wood, overgrazing in some parks, impact of tourism, and lack of training and funding for the rangers. There are a number of land related violations due to the illegal permission of land tenure right inside the strictly protected area site [18].

Tourists looking for pristine environments can be a major threat to the ecosystems. Impact from tourism is significantly increasing in some of the protected areas, despite clear regulation of the activities. However public awareness and information campaign are often lacking, due to a lack of infrastructure (e.g. demarcation marks) and communication plans. Implementation of new “eco-tourists” camps increased in protected areas in the last year. This will increase disturbances caused by direct pollution transfer to the water, fishing, and risks of forest fires in protected areas.

Moreover protected areas under represent some specific ecosystems in these basins and only a very small percentage of the protected areas are under the highest protection status (core zone status). Projects to extend or create new protected areas are being carried out, but do not necessarily focus on the Arctic catchment area. A better application of the existing environmental policies in national parks is needed to maintain biological reservoirs.

Important birds areas linked with aquatic systems are located mainly in the Orkhon, Selenge, Khuvsgul and Shishkhid river basins. Recent studies [75] reported that loss of riparian along wetlands and rivers, mainly due to livestock, has a significant impact on nesting capacity and finally on bird diversity.

Two RAMSAR sites lay in the arctic catchment area, Ogii lake and Terhiyn Tsagaan lake sites [76];[77]. The Terhiyn Tsagaan Lake located in the valley of the Suman River (Chuluut river basin) in the central Khangai Mountains. The maximum depth of the lake is 20 m. The shallow zone, up to 2 m deep, comprises 40% of the lake area. Lake area is then very sensitive to any drop of water levels. Water levels slightly decreased (about 80cm) in the last 15 years due to climate change [3]. It is an oligotrophic lake, and its altitude (above 2000m) limits temperature and then the risk of eutrophication. The lake hosted a small fishery mainly for pike and perches, but activities stopped in 1991. It is not known if small scale commercial fishing still occurs. The lake does not harbor vulnerable or endangered species of fish. The marshes at the west end of the lake are however an important breeding and staging area for migratory waterfowl.

The site is under the Khorgo Terkh national park protection status, but the area of the park is too big for only one ranger and the pastureland carrying capacity is overloaded by 2 times and more in the national park [37]. Furthermore tourist pressure increased in the last decade and 4 tourist camps lay now inside the National park, producing untreated garbage, increasing risk of forest fires, and disturbing bird migration.

The second RAMSAR site, Ogii Lake, is located in the valley of the Orkhon River. It is a shallow, mesotrophic, freshwater lake with an extensive alluvial area of grassland, river channels, and pools and marshes at the western end. The maximum depth of the lake is 16 m, but about 40% of the lake is less than 3 m deep, and 50% supports macrophitic growth. It supports an important community of fishes, mainly cyprinids but some salmonids such as Taimen have been reported to occur in the lake. Recreational fishing significantly increased in the last decade, but it is not known if fishing pressure has an impact on fish population. Concentration of livestock around the lake leads to a loss of habitats for rare migratory birds nesting around the lake.

National parks and strictly protected areas generally suffer from a lack of staff, tools and training to manage a proper protection of the areas. It is important to reinforce the protection of these areas which can act as biological reservoirs.

8.5.5. Climate change

Temperatures in the northern part of Mongolia are expected to increase. There are also clear changes in surface soil freeze in autumn and spring thaw in the mountains. The date of the freeze in autumn was delayed by 2-6 days when the date of the thaw in spring advanced by 2-6 days.

Annual mean temperature of permafrost has increased. Permafrost has a very important role for the hydrology of the rivers in these basins as it avoids infiltration and loss of water in soil during the snow melting process.

Surface run off should increase in these basins but will show a even higher variability than in the current situation. Changes in biological cycles and distribution of aquatic species will occur. Higher variability of run off will favor species that can leave in a wide range of conditions, and might impact species with needs for specific habitats (e.g. salmonids).

8.6. Human activities linked to the aquatic ecosystems

8.6.1. Domestic uses

Ulaanbaatar, Darkhan and Erdenet are the three bigger cities in Mongolia, with a growing population. A good wastewater treatment management is hence more important in these urban areas than any other place in Mongolia. Industries and mining sites often have their own wastewater treatment plant, due to the particular characteristics of the effluents. In these three major cities, problems have been reported concerning treatment efficiency.

Ulaanbaatar wastewater treatment plant efficiency is around 60/70%, due to poor maintenance, outdated equipment and power shortage. Even short power shortage can have significant impact on the treatment efficiency; for instance, a one hour power cut leads to 4500m^3 of untreated wastewater pouring into the river. The process suffers also from non pre-treated industrial effluents which significantly perturbate the treatment of the domestic effluents.

There are just a few tributaries downstream of Ulaanbaatar that help to increase the self-purification capacity. According to Munguntseteg [78], river was self-purified only 170 km after the point source pollution of the wastewater treatment plant in 1982. More recent study showed that pollution of the Tuul River was not entirely purified 35km after the WWTP discharge in the Tuul. Other sources report that the Tuul River water was once self purified at Altanbulag but this distance has now increased by two times [79].

Trends in water quality through showed that quality was steadily deteriorating downstream of the WWTP between 1996 and 2006. Isotope analysis carried out in June 2006 showed however that the discharge of municipal sewage from Ulaanbaatar does not influence the nitrate concentration of the Tuul River. However ammonium concentration exceeded by 10 times the norm downstream of the waste water discharge location.

The impact of Ulaanbaatar city waste waters affect then a very long stretch of the Tuul river, and water quality is deteriorating from year to year. Moreover, industrial waste water is not properly pre-treated, which affects significantly the effectiveness of the central treatment plant.

Erdenet city wastewater treatment plant is in undercapacity. However data on water quality do not show signs of degradation in the Khangal river, concerning indicators such as DOB and nutrients.

In the Kharaa valley, a succession of cities with inefficient wastewater treatment plant leads to a severe degradation of surface water quality, with increasing nutrient and organic pollution in the mid and downstream reaches of the river.

Due to the lack of data, it is hard to assess whether or not other domestic pollution represent a significant threat to the aquatic systems. Many soums center do not have proper waste water treatment facilities but water use and density are low, reducing the risk of pollution to nearby water bodies.

Waste water treatment plants are very often outdated and in undercapacity. The self-purification capacity of the receiving water body can sometimes compensate the lack of waste water treatment but this is not the case for the biggest cities which are located in these basins. Furthermore demography still tends to grow and there is an urgent need to implement proper wastewater treatment facilities taking into account the future development of the cities.

8.6.2. Agriculture and irrigated areas

Agriculture is developed mainly around the main cities such as Ulaanbaatar, Darkhan, and Erdenet. The wide open valleys are very suitable for the implementation of irrigated areas. Main areas of agro-industrial farming are concentrated in the Kharaa valley and on the right bank downstream of the Orkhon river.

No significant use of fertilizers has been reported until now. Batimaa reported that fertilizer application to arable land in Mongolia is low compared to some other countries where arable land is well developed. The total application of fertilizers is on average 30-40 kg ha-1 (2000). Mainly chemical fertilizers such as ammonium nitrate, double super phosphate and potassium chloride are used.

Nutrient concentration, such as nitrogen and phosphorus, are low in most of the basins. Increasing concentrations of phosphorus and nitrogen have been reported downstream of the Orkhon and in the Kharaa river basin, but are below the water standards.

This trend could also be explained by domestic pollution or concentration of livestock in the vicinity of the river. However, as cropping production is meant to develop in Mongolia and as soils in these basins do not contain a major content of nitrogen and phosphorus, fertilizer application could drastically increase in the next years. The majority of the fields are in the vicinity of the rivers, where land is flat and water availability high. Fertilizer transfer can easily occur to the water bodies, especially as intense precipitation occurs in the valleys.

Some practices increase the erosion process. For instance, furrows are often in the direction of the steepest slope, which increase the erosion of the fields, leading to higher particle content and increasing concentration of nutrient in the river. Training for better agricultural practices would limit this problem and avoid the loss of rich and valuable soil during summer rainfall.

Development of irrigated area in the Kharaa valley is planned by current national land-use policies, which are aiming at (re-)converting additional 50,000 ha for agriculture in the next years, with most of the land being located in the Kharaa and neighboring catchments. Simultaneously, due to the ongoing intensification, an increase in water abstraction for irrigation purposes is expected. Irrigated crop production might be limited by water availability, even if increasing demands of other water users are not considered. Water demand for irrigation will change the environmental flow and might reduce habitat availability.

Even though agriculture does not appear as an issue for environment or water quality nowadays, the development of cultivated areas and the future need for fertilizer to ensure a good production will have significant impacts, especially in Kharaa valley and downstream of the Orkhon river.

8.6.3. Pasture

Livestock number has significantly increased in these basins from 1992 to 2000, before a brief decrease due to harsh winters. Proportion of goats for cashmere production has increased significantly. Goats have a stronger impact on soil degradation than any specie of livestock as they have a wider range of food source and due to their natural grazing behavior which involves uprooting vegetation.

For the purpose of watering pasture land, more than 7,000 wells were built between 1954 and 1990 in the Selenge drainage basin. At present, about 40% of all these wells are not functional, and the amount of pasture land decreased. Even though data on areas used for mining purpose are not well defined due to a high part of illegal mining sites, development of this activity especially in the northern basins of Mongolia has reduced access to pasture areas and migration ways. As in the rest of the country, this leads to a greater concentration of livestock in the vicinity of surface water bodies, mainly around soum centers. Impact from livestock dung on bacteriological quality has not been observed yet, but just a few studies exist. Moreover, in springtime the frozen manure is washed to the river course by melting water. This event lead to high nutrient input. The related fecal contamination of river water may cause sanitary problems for the drinking water especially for livestock drinking water straight from the river.

Trampling and consumption by the livestock of the riparian vegetation is another type of impact that should be taken into account as it leads to a higher erosion, increasing turbidity in surface water and a significant loss of habitats for aquatic species.

As in the rest of the country, available pasture area is limited by water availability but suffers as well from the growing occurrence of mining sites in the floodplains. Livestock concentrated in the remaining available areas lead to rapid land degradation that might become irreversible. Rehabilitation of existing wells could increase available pasture area and limit impact on vegetation. Rehabilitation of former mining sites as well as a proper management of areas conceded for mining exploitation is needed to let enough land for pastoral economy.

8.6.4. Industries-mines

Gold deposit of both hydrothermal and placer types occurs in many valleys, especially in the Eroo, Kharaa, Tuul and Orkhon river, though registered exploitation sites take place in every basin except the Ider river basin. Copper deposit occurs in Erdenet, in the Orkhon river basin. Other types of mineral deposits such as iron skarns and vein type tungsten also occur in the study area, but those are minor in economic importance. These basins supports different types of mining activities, from small scale illegal mining to large scale mining.

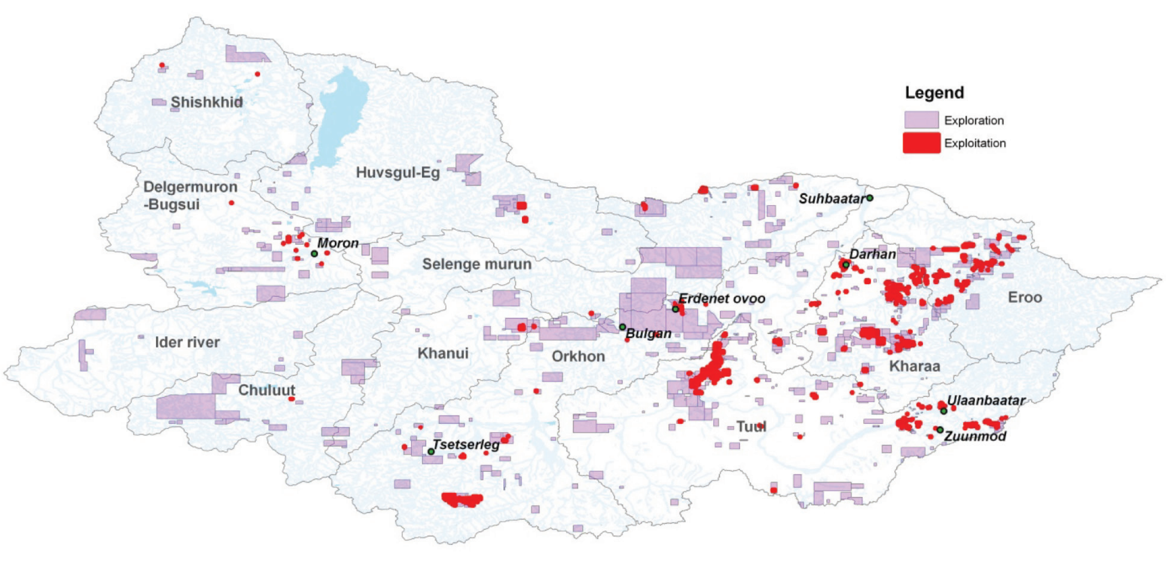

Figure 38. Mining exploration and exploitation in the Arctic basins cluster

Implementation of mining sites resulted in the loss of riparian vegetation, changes of river morphology, removal of fertile soil, and straightening of the river bed. Mining activities has heavy impacts on the surface water quality; turbidity downstream of the mining site was more than 500NTU in 2006. Additionally to the physical impact of turbidity, transfer of nutrients, especially phosphorus occurs. Heavy concentrations were found to be significantly higher than the permissible levels for all points near mining sites, as well for phosphate, ammonium and cyanide [79].

The Zaamar gold mining district is located some 180km northwest of Ulaanbaatar in the Tov aimag, along the banks of the Tuul River. To provide process water for the placer wash plants, water is pumped from the Tuul River. The water management is reported to be not effective as large amount of water are pumped from the Tuul, exceeding the needs. Furthermore it makes the effluent much more difficult to get treated.

Technological impacts of the Zaamar goldfield along the Tuul river have been studied by Byambaa et al. in 2011 [81]. They reported than the type of recovery process had a significant importance regarding the release of heavy metals in the river, with dredge being the most pollutant type of recovery process, whereas sluices and scrubber were significantly less pollutant regarding heavy metals concentrations in the surface water. Taking into account combined pollution, including release of nutrients and cyanide, scrubber was the least impacting recovery method. This shows that the type process used in Zaamar goldfield has a strong influence on the degradation of water quality. However the same study reported that the results from the empirical analysis and show that domestic owned mines have more impact on the water quality than the mines run by foreign companies, usually using newer technology such as dredges.

It is not clear yet what the self-purification capacity is of the Tuul River at this site and how many kilometers of river is impacted. High pH values in water found on this site lower the mobility of the heavy metal in the water, however they might travel downstream bound with fine soil particles.

Nevertheless, the disturbance creates a riverine fragmentation, which limits the possibility for aquatic species to migrate upstream of downstream of the Tuul or to the tributaries.

The Erdenetyn-Ovoo copper ore deposit is located close to the town of Erdenet on the shore of the Khangal River, which flows in the Orkhon River. The deposit was discovered and explored between 1960 and 1972.

Sampling downstream of Erdenet city showed a strong increase of total suspended solids, conductivity, sulphate concentration, as well as a drop of dissolved oxygen concentration. Concentrations of nickel and manganese were found to be above the norm just downstream of the tailing pond in the Khangal river, whereas cadmium, copper, and arsenic were just below the norm. Isotope analysis suggested that high level of sulphate contained in Khangal river is derived from the oxidation of Cu-Mo ore, hence released form the mining site rather than urban effluents. Once the Khangal river reach the Orkhon River, dilution lowers the concentration of these toxic substances.

However recent increasing mining activities in the tributaries of the Orkhon valley steadily impact water quality on the whole length of the river. Once the concentrations of toxic substance reach a certain threshold, loss of biodiversity will rapidly decrease and the capacity of recovery of the system will be severely impacted.

A large number of belowground and open pit (gold-) mining concessions have been issued during recent years within the catchment of the Kharaa River, mainly in the upstream tributaries. The total area currently covered by mining licenses is about 130 kmI (not including illegal ‘ninjas’), but it is unclear how many mines are actively being exploited. As many of these mining sites are concentrated in a small area, impacts on the water quality and habitats are significant in this basin, as continuous effects along the streams do not allow a proper self-purification. Heavy metals concentration exceeding the norm, loss of riparian vegetation, changes in river morphology, deforestation for mining purposes and substantial amount of water withdrawal does not affect just streams in the vicinity of the mining sites but has effect of the whole river basin.

Significant content of mercury have been found in Dace fish tissues in the Orkhon and the Eg river (in average respectively 0.21 and 0.2 mg/kg dw, maximum concentration in the Orkhon with 0.38 mg/kg) [82]. These concentrations do not reach lethal concentration for fish, but can induce physiological effects on equilibrium and vision, perturbing movement and feeding capacity. Moreover mercury content might be higher for fish which are higher in the food chain (e.g. pike, lenok). These fish can considerably bioaccumulate heavy metals especially as they can live for years.

Taking into account the recent use of mercury in mining processes and the current increase of mining activities, there is little doubt that these concentrations will increase in a near future.

Due to the illegal nature of the activity, it is not possible to find records of the number of ninjas in Mongolia. “Ninjas” are most present in Selenge aimag (nearly 20,000 ninjas), Ovorkhangai Aimag (15,000) Arkhangai Aimag (14,000) and Tov Aimag (12,000), related to around 100,000 ninjas in all Mongolia (2003) [40]. Some other reports state only around 50,000 ninjas in Mongolia (2004) [31].

Informal placer mining started first in Selenge and Darkhan-uul aimag in 1995-96, spreading to other neighboring aimags. The causes of regional variations in distribution of ninjas are fairly clear. The MBDA survey demonstrated a close correlation between the geographical distribution of ninjas and formal gold mining. With the ongoing spread of formal gold mining, it is anticipated that ninjas will rapidly increase in those areas also.

Impacts on surface and ground water are various, mainly affecting river banks and releasing fine particles in streams. Use of heavy metal, such as mercury, is widespread but do not occur in every informal placer mining site [31].

Though Mongolian laws include that land that has been damaged from digging for mining purposes is to be restored, remediation is not often carried out, or not properly. This is often due to a lack of a proper environmental monitoring program, and a lack of knowledge regarding proper remediation techniques.

Lack or improper rehabilitation of land can be a good terrain for the settlement of invasive species, as reported by several studies [83] In case remediation is carried out, especially revegetation of floodplain, a special attention should be paid to use proper species and as reuse local soil as much as possible.

Mining activities have significant impacts on water quality, morphology of the river, and aquatic habitats. The Tuul, Orkhon (Khatgal River), Kharaa and Eroo basins seems to be the most affected. Disturbances are apparently limited to small stretches of the rivers, though there is a lack of study to assess the real capacity of self-purification in these streams. However the increasing number of mining sites, either formal or informal, limits the capacity of the rivers to dilute or to absorb fine particles and toxic substances such as heavy metals.

Increasing use of heavy metals is a great concern not only for aquatic species but for human health as well as consumption of contaminated fish can trigger adverse effects including neurological dysfunction. Livestock or products from irrigation can be impacted with the intake of polluted surface water. Furthermore contamination of the soil can occur downstream as fine particles containing heavy metals will deposit in the floodplain during floods. This can lead to long term contamination of valuable pasture land and affect livestock productivity and quality. Further studies should focus on heavy metal transfer through the food chain including livestock and crops.

Furthermore, mining sites creates a fragmentation of the ecological continuum that limits migrations of aquatic species and fragment population. This leads to a decrease of population and a loss of biodiversity even in parts of rivers which seems undisturbed. Furthermore the loss of the rich floodplain pastures may pose a long-term threat to the sustainability of human settlements in the region.

Choice of recovery technologies seems crucial to limit impacts on surface water quality, regarding heavy metals and turbidity. A better knowledge of the process used for each mine and the potential impact for each technology is needed. Simple and easy to implement techniques such as better design of settling ponds to increase sedimentation of particles, as well as a better maintenance of the settlings ponds would have a significant effect on the reduction of turbidity and concentration of nutrients and heavy metals in the surface water.

The development and the impacts of informal mining are however hard to monitor and may have a stronger impact than formal mining activities. Moreover, due to the illegal nature of the activity, it is much harder to implement public awareness or less impacting technology.

Due to fish specific biological cycles, proper spawning sites are limited along a stream. Destruction of these sites, for instance by clogging process due to the release of fine particles would have an immediate impact on fish population, even if other habitats are left undisturbed. Monitoring of such sites is needed and actions should focus on their preservation. Mining concession should not be permitted within these sites to allow renewal of fish population, especially for salmonids, as Taimen, lenok and Arctic graylings are a valuable resource of income due to recreational fishing.

Tanneries are concentrated in the bigger urban centers such as Ulaanbaatar, Darkhan, and Erdenet. 46 tanneries were registered in Ulaanbaatar in 2008 (26 functioning permanently, the rest of them work during winter time only).

They all use chromium-based technology to process skin and wool [84]. All tanneries are supposed to pre-treat their waste water and to be connected to the central waste water treatment plant. However in Ulaanbaatar most of the new settled tanneries do not have waste water pre-treatment plants and are not connected to the central sewerage [85].

Chromium (Cr) has toxic effects at low concentration, in soil and water, and a strong capacity to bioaccumulate in plants, macroinvertebrates and fish. Chromium can be found into two stable forms, trivalent chromium (Cr (III)) and the hexavalent Chromium (Cr (VI)) which is more toxic. Utilization of hexavalent chromium (Cr (VI)) is forbidden but some small tanneries still use this compound

Sampling in 2005 revealed that mean levels of chromium in wastewater sampled August 2005 from the pre-treatment plant were 1184 mg/l before and 29 mg/l after treatment (removal efficiency 97.5%), but removal efficiency dropped to 58% during peak tannery production (November to March). Pre-treatment plant effluent exceeded the Mongolian national standard (5 mg/l) regardless of season. Chromium was not detected in river water samples, but ranged from 15 to 64 mg/kg in sediment samples downstream from the central WWTP outfall [86]. Significant levels of chromium in surface water have been reported in the in the Kharaa river downstream of Darkhan as well. They did not exceed the standards but no long-term monitoring exists for this element on these sites, to assess the annual variability of chromium concentration, which highly depends on tanneries activity. Analysis of sediments and biological components are needed to assess the level of chronic chromium pollution, and its resilience on a spatial dimension.

Mongolian treatment plants are not designed to handle heavy metal pollution in waste water. As the economy coming from the tanneries is important and use of chromium is almost impossible to ban, proper pre-treatment systems on site are the only solution to reduce the transfer of trivalent chromium in the river systems. Recent studies showed that the use of zeolite during the pre-treatment process, a mineral easily available in Mongolia, gave good and cost-effective results to decrease chromium contents in waste water. In the same time, ban of hexavalent chromium should be reinforced.

8.6.5. Forest management

Though logging is steadily increasing, the main threat to forest cover remains the occurrence of forest fire in Mongolia. According to Krasnoshekov [88], about 75% of loss of forest area is due to forest fires, though percentage of area impacted by logging might be higher in the Arctic Ocean basins due to the high demand of wood close to the urban centers.

Forest fires have then a stronger impact than timber harvesting but occurrences in time and space are highly variable. The Arctic ocean drainage has a high forest cover compare to the national average and is where most of the forest fires occurs. Forest fire prevention and protection is one important issue for aquatic systems as burned forest would trigger the same effects on streams and river quality than clear cut forest.

Mongolia has two fire season peaks, one from March to mid June which accounts for 80% of all fires, while the other peak is from September to October which accounts for 5% of all fires. Areas destroyed by forest fires have increased after 1995 [88], where management abilities were weakened and aerial detection and airborne firefighting program disappeared. On average about 50-60 fires occur annually and the largest occurrence of the fires are human caused though not intentionally [89]. Number of forest fires increased in the last decade, but proportionally number of hectares destroyed by fires increased even more. The cause is the improper forest management leaving

Main causes are the use of equipment such as chainsaws which produce sparks, as well as exhaust pipes of vehicles used for transportation of wood. Fires often start far from inhabited areas [89].

Other causes reported are campfire left carelessly and use of tracer bullets for hunting. Recent rise of the temperatures due to climate change can increasing the risk of forest fire, by lowering moisture content in vegetation.

Actual tools to fight against forest fire are not adequate in Mongolia, with a lack of equipment, surveillance and training reported by different studies [37;89]

Forest is one of the most valuable resources in these basins, used for fuel wood or constructions. Abundance of forests and proximity with demanding cities such as Ulaanbaatar, Darkhan and Erdenet creates an important activity, including legal and illegal forest cutting.

Provenance, type and quantity of wood use is not easy to establish, as a significant (between 36 and 80 % of the total harvest) part of the total harvest is illegal. Most of the fuelwood consumed in main cities is obtained from small area, as the economics of fuelwood supply do not allow for high transport costs. Fuelwood is usually cut only 20–70 km from the point of sale, but is occasionally transported from more distant locations. As fuelwood is indispensable for cooking and household heating, its consumption cannot be limited by laws or regulations. Furthermore it has been shown that legally authorized supply of timber is far below current levels of consumption. This constitutes one of the main causes of the increase in illegal logging.

Some 70% of the sources of rivers and streams of these basins come from the mountain forest zones, therefore decreases in the forest stock and area would have adverse effects on the diverse functions of the basin in terms of ecological hazards and socio-economic impacts. Forest cover is the most important runoff generation area in the basins. It has a damping effect on river discharge, reducing surface run off. Reduced forest density will lead to an acceleration of the snow and permafrost melting process in spring, as shadow cover reduced. Forest cover prevents soil erosion during heavy rainfall occurring in spring and summer, and limits transfer of nutrient to the streams.

Models in the Kharaa river basin showed that a reduction of forest cover lead to a strong increase of runoff peaks. A 90% reduction of forest cover would almost double run off peaks in comparison to the calibration period, clearly showing that land-cover changes strongly influence runoff generation. Hence, deforestation due to forest fires or wood cutting would aggravate the contrast of flood and low flow conditions. This would lead as well to a stronger erosion of the riverbed and increase the amount of total suspended solids in water, degrading water quality for long distances.

Even if mainly dead wood is harvested for cooking and heating purpose, it should not be assumed that it has not impact on ecological processes. Dead wood participate in regulating snow melt period as well as surface run off and are important habitats for macroinvertebrates and fish when flooded by inundations. Clear cut area is then often use as a pasture area. Young shoots of trees are destroyed by livestock, leaving small chances for the forest to regenerate.

Technologies used for timber harvest are reported to be often inefficient, as cheap supplies of illegal timber provide no incentive to reduce wood consumption. This lead to an over-utilization of the forest compare to the real needs.

Management of forest resources in situ and production of timber should be improved. Forests should be managed under long-term plans that identify the appropriate harvestable forest areas and optimum harvest rate. Industrial use of relatively abundant and fast-growing species such as birch could also be increased, as these trees are currently not often utilized.

Forest pest is an increasing problem as well in Mongolia, mainly affecting pine trees. Pest outbreaks historically occur approximately every 10-12 years with increasing intensity. In recent years, the drought conditions have contributed to a reduction in time between cyclic outbreaks. Suran [90] reported that in long term massive insect defoliation occurred in each 13-15 from 1970s to 1930s in the Bogh Khan area, but also that almost each 3-year outbreaks had occurred in each sites of this forested area since 2000.

Pest incidence is affected by climatic conditions compounded by wildfires, logging damage, and permafrost, which all weaken the trees and make them more susceptible to insect infestation. Forest impact is widespread in these basins as northern forest areas including Selenge, Tuv, Khentii, Dornod, Arkhangai and Bulgan experienced rapidly increasing populations [66]. Gypsy moth (*Lymantria dispar L.*) and Siberian moth - *Dendrolimus superans sibiricus* are the major pests in the forest-steppe ecotone of Mongolia [91].

Continuous attempts have been made by the government to control outbreaks of the Siberian caterpillar, Dendrolimus sibiricus*, and other defoliators but the vast areas, lack of trained personnel, limited facilities, financial constraints and poor equipment coupled with extreme weather events makes pest management a monumental task.

In these basins, forest cover is heavily impacted by fires, over utilization of wood resource for fuel wood or construction purposes, and forest pests. Forest fires are the most important factor of deforestation on a general scale, especially from the mid-1990s due to a lack of management and tools against forest fires. Easier access to remote forest areas by legal or illegal loggers increases as well the risk of starting a fire. Over utilization of wood, legally and illegally, mainly occurs in the vicinity of urban centers where the demand is the highest.

Increasing deforestation has a wide range of negative impacts on natural conditions in these basins; significant changes in natural river regime, increasing concentration of nutrients and fine particles in the water will affect ecological processes on long stretches. Reinforcement of patrols during forest fire seasons and better forest harvesting techniques would reduce risk and the damages caused by forest fires.

8.6.6. Tourism

Due to the vicinity of large urban centers and better transport infrastructures, the area of the Mongolian arctic basin is generally more developed than in other part of Mongolia. Impacts from tourism can be various: point source pollution from tourist camps with wastewater or solid wastes, disturbance of areas with a specific ecological interest (e.g. strictly protected areas or migratory birds nesting sites), direct pressure on aquatic species, such as recreational fishing (*described in 9.5.7*). On the other hand, tourism brings a significant source of income for population, and number of tourists attracted by the natural aspects of Mongolia is increasing. It is therefore necessary to maintain a certain degree of ecological protection to maintain the attractiveness of the ecosystems.

Very few studies exist on a province level to assess the income generated by tourism and the kind of pressure related to environmental issues. As wilderness is one of the most attractive aspects of Mongolia for foreigners, tourists will tend to access areas that are still preserved from human impacts. Number of tourist camps steadily increased, especially in natural park and protected areas. Even though environmental policies are clear in these areas and number of rangers sometimes sufficient, a lack of public awareness and infrastructures limit their application. Implementation of new tourist camps in protected areas should be limited and accompanied with proper management of tourist practices.

8.6.7. Fishing

Commercial fishing of Taimen has been reported to increase in the last decade. Most fish are caught by local fishers who sell them at local markets or illegally export them to China and Russia. Most of the poaching happens in winter when Taimen gather in deep ponds when rivers are frozen. Due to the illegal practice, no records exist on catches of Taimen in these basins.

Recreational fishing, mainly done by foreign tourists during summer time, is suspected to have an impact as well on the Taimen population. The growth and natural mortality estimates and the population model results done by Jensen et al. suggests that Taimen populations are likely to be very sensitive to fishing mortality [92]. Recreational pressure increased in the last years with increased access to organized tours, fishing supplies and all-terrain vehicles.

Catch and release practices are known to be have little impact on fish population [92]. In the case of Taimen in the Eg–Uur watershed, the existing catch–release recreational fishery has likely reduced Taimen abundance, biomass, and mean weight by less than 10% compared with levels predicted in the absence of recreational fishing. In comparison, if all Taimen caught in this fishery were retained (as they are elsewhere in Mongolia), they reported that there is a 57% chance that such harvest levels, if maintained, would lead to the eventual extirpation of the population.

Migrations of Taimen have been to occur most in May and June (spawning and postspawning period), with another peak period of movement in September and October when Taimen return to deep ponds. Changes in land cover, mainly loss of forest cover may trigger changes in migration pattern of Taimen. Reduce shadow cover will accelerate snow melting process in spring, changing the hydrology of the rivers; as Taimen migration is influenced by temperature and discharge changes, current changes of natural regime driven by deforestation and climate change will have an impact on biological cycles.

Mining practices not only affect some parts of river suitable for valuable fish, but lead as well to a concentration of fishing pressures in on disturbed areas. Chandra [93] reported that local population would fish upstream of the mining sites or on non disturbed areas to practice recreational and commercial fishing. This is an indirect impact of mining activities, by concentrating fishing pressure in the only suitable areas left for salmonids. Tuul, Eroo, Kharaa and Orkhon fish population seems to be the most heavily impacted by large-scale placer mining operation. Sedimentation and clogging of fish habitats associated with overgrazing appears to be the main threat in Orkhon, Selenge, Ider and Chuluut rivers, and organic pollution is being discharged in sections of Tuul and Kharaa rivers.

Public awareness about capture size would need reinforcement as well. As many of the species in these basins reach sexual maturity late, uptake of non mature fish has a big impact on renewal capacity. Promote catch-and-release amongst all anglers (foreign and Mongolian) and publish catch-and-release guidelines is needed to ensure the sustainability of fish composition in these basins.

There has been concern over impacts due to the use of jet boats by tourists in the bigger rivers such as Selenge and Eg uur. However recent studies suggested that jet boats do not have a significant impact on bank erosion. Water pollution might come from leakage of fuel or oil from the boats but it is not reported as an issue yet.

Protection should focus on some yet undisturbed areas suitable for spawning, where fish stock could regenerate and then develop downstream. Protection of these zones should be accompanied with a proper protection of forests and illegal mining. Existing protected areas are not sufficient to guaranty a proper protection of rare and valuable fish such as Taimen.

Recreational fishing in the bigger lakes such as Khovsgol Lake and lakes in the Darkhan depression has not been reported to impact fish stocks.

Commercial fishing occurs mainly in lakes in theses basins, principally in the Shishkhid and Khovsgol basins, and happens mostly during winter season when they can be preserved by freezing under the prevailing very low temperatures.

Many organized fisheries started several decades ago, but it is not easy to have recent data on caught fish and composition of the fish stock. Nowadays commercial fishing occurs mainly under the form of illegal commercial fishing at a small scale, as a seasonal complement for income. This makes it difficult to establish zones where it has the biggest impact.

The GEF “Conservation of the Eg-Uur Watershed” project [94] reported in 2003 that commercial fishing run by locals is a minor threat for fish population compared to recreational fishing in the Eg-uur river basin. But according to the UICN red book of fish, commercial fishing in these basins is a threat for several rare of endangered species. High occurrence of valuable fish and proximity with Russia for export might favor this activity in the most northern basins such as Eg, Shishkhid and Khovsgol river basins. Due to the lack of data concerning number and composition of catches, it is not possible to assess if commercial fishing has an impact on fish species composition in the Arctic catchment area.

8.6.8. Dams and flow regulation

Three small hydro power plants are present in the basin. Production is limited, ranging from 200kWt for the Erdenebulgan in Eg river basin to 528kWt for the hydropower plant of Kharkhorin on the Orkhon River.

Table 24. Hydropower plants in the Arctic Ocean basins cluster

Name	River	Basin	Capacity	Estimated head, *m*	Fishway	Flushing-gate
Tosontsengel	Ider	Ider	380	3	No	No
Erdenebulgan	Eg	Eg	200	4,5		
Kharkhorin	Orkhon	Orkhon	528	11		

Potential to implement new hydropower plant seems to be highest in the Orkhon and Selenge valley, with many projects of dams' implementation being carried out (Figure 39).

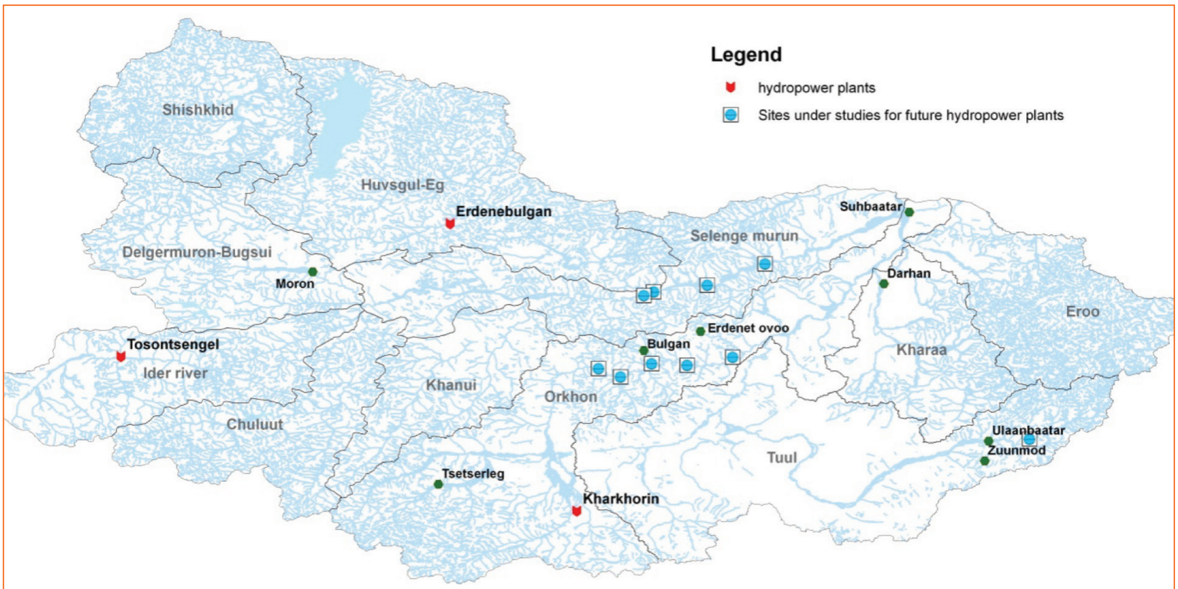

Figure 39. Locations of existing and potential hydropower plants in the Arctic basins cluster

Data about variation of river discharge, sediment balance, habitats and occurrence of flooding are missing now to carry out a proper assessment of the ecological impacts for each project. However some impacts can be qualitatively described.

Implementation of dams will result in a multitude of impacts for the natural conditions of the river, even if measures such as implementation of flushing doors, fishways or regulation of the discharge to mimic natural conditions are implemented.

Dams will stop or reduce the occurrence of flooding in the plain downstream of the site. This will not just impact aquatic species which need specific regime conditions to develop their biological cycle (e.g. pikes which can spawn only in flooded plains), but this will limit valuable nutrients and water to the pasture areas. Reductions of vegetation cover hence valuable pasture areas in the floodplain downstream of the dam might occur. This will increase soil erosion process in the vicinity of the river and increase turbidity in the flow remaining after the dam.

This effect will not just occur just downstream off the dam. The lack of sediment coming from the upstream part of the basin will trigger erosion and incision of the river bed. Loss of morphogenetic discharge will impact as well the braided characteristic of the rivers and reduce habitat changes and biodiversity. Self-purification capacity will decrease as well, as discharge and lateral connectivity will reduce.

Dam will flood long stretches of rivers that may harbor spawning sites for endangered species. Dams create a lentic environment up stream of the dam, where particles will sediment rather than being transported downstream with the flow. Fish population will shift from salmonids to cyprinids in the reservoir. Biodiversity, as the distribution of different species in a river might increase, but this will be due only to the creation of an artificial system. On one hand, these artificial lakes may attract recreational fishermen on the site but on the other hand the loss of other habitats and reduction of more symbolic fish populations upstream and downstream might have a bigger impact on recreational fishing.

Water will warm up and concentration of nutrients might induce eutrophication and appearance of anoxic conditions in the bottom of the reservoir. Anoxic conditions will favor creation of methylmercury [95] which is more likely to enter the food chain. Sediments in the reservoir should be analyzed before any flushing operation.

If a flushing door is implemented, operation should be carefully studied as the release of a high content of fine particles in a short time, possibly contaminated by mining operations upstream will have harmful impacts on biology and water quality.

The height of the projected dams (>40m) does not allow the implementation of cost-effective fishways. Populations of aquatic species will be separated, and may reach a critical number where populations are not sustainable especially if several dams are implemented on the same river.

8.7. Summary of the main pressures in the Arctic basins cluster

The Mongolian basins of the Arctic Ocean catchment area support the majority of human activity and economy of Mongolia. Impacts and uses linked to the aquatic ecosystems are numerous. On a general scale, mining activities and forest management are the biggest issues for these basins, affecting natural flow, habitats and water quality on almost all the river basins. Industrial and domestic pollution surpasses self-purification capacity of the rivers and heavily degrades natural conditions downstream of the bigger cities on long stretches. These activities perturb not only the natural functions of the ecosystems but have impacts on other economic activities, such as livestock productivity and tourism.

Forest fires have generally a bigger impact than logging, but are often triggered by poor logging practices, for example leaving important amount of dead branches on the soil that can easily burn and spread forest fires on important areas. A better forest management, with control of harvested areas and proper logging technologies would limit the loss of forest cover.

Table 25. Main pressures in the Arctic basins cluster

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services
Climate change	Higher variability of run off	Changes in surface water flow and lake levels. Changes of habitat distribution	
Pasture	Increase of livestock number and concentration around water bodies.	Increasing land degradation Destruction of riparian vegetation. Perturbation to wildlife (birds) in the vicinity of lakes Locally, possible bacterial contamination especially around urban areas.	Irreversible destruction of pasture areas. Source of infection for human health and livestock
Commercial and recreational fishing	Over fishing	Decrease of the fish stock impacting endangered fish populations	Decrease of attractiveness for recreational fisher men.
Introduction of invasive species	Introduction of fish species in 1960-1980s Risks of invasive plants on former mining sites	Impact on endangered species (Arctic whitefish) Possible destruction of endemic species and changes of riparian system	Risk of competition with valuable fish species (recreational and commercial species)
Mining activities	Physical impact on river bed Release of fine particles of soil in the streams. Illegal use of heavy metals.	Strong degradation of water quality downstream of the mining sites. Impact on morphology and riparian vegetation, changes in natural river regime. Degradation of habitats Contamination by heavy metals	Toxic effects on human and livestock health. Important loss of pasture areas. Loss of attractiveness for recreational fishing.
Dams	Disruption of connectivity. Changes of natural flow, destruction of spawning sites downstream and upstream. Eutrophication in the reservoir.	Impacts on natural habitats and spawning sites for fish upstream and downstream. Impact on fish population (number and composition). Degradation of water quality	Loss of pasture area. Impact on recreational fishing. Loss of self-purification capacity
Domestic pollution	Release of untreated or not well treated wastewater in the rivers	Degradation of water quality and loss of biodiversity on long stretches of rivers downstream the main cities	Possible loss of productivity for livestock and increasing water treatment costs
Tourism	Increasing number of ger camps	Disturbances for wildlife Local pollution of sites with specific ecological interest	Loss of attractiveness for tourism and wildlife seeing
Forest fires Overlogging Forest pests	Loss of forest cover	Changes of river natural regime Increasing transfer of soil particles and nutrients in the streams	Impact on habitats for fish leading to a loss of commercial fish stocks. Loss of self-purification capacity Impact on water quality
Irrigation	Water withdrawal from rivers Possible increase of fertilizer use, especially in Orkhon and Kharaa	Changes of natural river flow during summer. Possible increase of nutrient concentration in surface and ground water	Loss of self-purification capacity. Degradation of drinkable water quality.

Even if groundwater quality often fits the standards, contamination of shallow aquifers from heavy metals is a raising issue. Actions should be implemented to avoid a long term contamination of groundwater, especially in the basins where use of mercury or cyanide for mining activities is increasing. Taking into account the mobility and remoteness of illegal mining activities, patrolling for illegal miners using heavy metals can be difficult and not effective. Limiting the availability of heavy metals on the market before they reach mining sites could be an efficient way to decrease mercury and cyanide use, hence the risks of pollution.

Concerning legal mining sites, choice of recovery technologies seems crucial to limit impacts on surface water quality. However, due to a lack of general survey, it is not clear yet what recovery techniques are the best to implement. Future authorizations for mining activities should take into account the choice of the recovery technology and favor technologies with the lowest impacts. Efforts on land rehabilitation should be emphasized. This would not only reduce the risk of apparition of invasive species and recreate new habitats, but would limit illegal mining that often occurs on former mining sites.

Impacts from recreational fishing increased tremendously in the last decade, leading to a major loss of vulnerable and endangered fish population. This activity brings a valuable and growing economical resource via tourism. Decrease of fish stock due to a high mortality rate, degradation of water quality and loss of habitats will reduce the attractiveness of the region. Public awareness on catch-and-release techniques, and a better management and protection of salmonids population, especially Taimen are urgently needed.

The Orkhon and the Selenge basins have the highest estimated potential for hydro power generation and may support hydropower plants in a near future. Though hydropower is sometimes considered as eco-friendly as it does not directly produce green house gazes, hydropower plants have a wide range of adverse impacts on the aquatic systems. The implementation of hydropower plants will generate conflicts not only of the dam sites but on long stretches of rivers upstream and downstream. Ecological impacts and loss of ecological services should be carefully studied on a long term basis, and studies should especially take into account the cumulated impacts of a succession of dams in the same river network.

9. Main pressures on the national level

9.1. Summary of the main pressures

Most pressures and processes affecting water quality and the ecosystems occur on the national level and are not specific to a certain area or location. Table 26 summarizes the main pressures occurring on the national level, their impacts on the ecosystems and on the ecological services, and proposes guidelines for remedial actions or further studies.

The pressures occurring in each cluster of basins are detailed and described at the end of each chapter of the six clusters.

National maps (Figure 40 to Figure 49 in Chapter 9.2) represent the locations of some of the known pressures. It should be noticed that only the locations where significant pressures have been confirmed by data or studies are shown on the maps. The locations shown on the maps are hence not exhaustive.

Table 26. Summary of the main pressures on the national level

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services	Recommendations
Climate change	General increase of run off, but with a higher variability. Increase of potential evaporation	Reduction of lake sizes in the Gobi basins Changes in surface water flow and lake levels. Loss of soil moisture and land degradation especially in floodplains.	Loss of water availability for population and livestock in shallow lakes	Repair and maintain wells to increase water availability. Limit concentration of livestock in the vicinity of water bodies.
Increase of livestock number (especially goats) Concentration of cattle around water bodies.	Overgrazing	Increasing land degradation (erosion and release of fine particles in water). Destruction of riparian vegetation. Locally, possible bacterial contamination, especially around urban areas.	Irreversible destruction of pasture areas. Source of infection for human health and livestock, decreasing productivity. Impact on habitats for fish leading to a loss of commercial fish stocks.	Repair and maintain wells to increase water availability and limit concentration of livestock in the vicinity of water bodies. Prepare appropriate management plan for buffer zones in protected areas, taking into account grazing capacity.
Commercial fishing	Over fishing	Decrease of fish populations Impact on bird food source.	Massive drop of fish stock for commercial uses. Impact on tourism (fishing and bird watching)	Change of environmental policies in protected areas. More flexible policies to manage a sustainable exploitation of fish stocks.
Introduction of invasive species	Introduction of muskrats for commercial use (fur). Colonisation by new species from Russia and China	Destruction of riparian vegetation and changes of fish species distribution	Muskrats: Decrease of habitats that could lead to loss of fish stock. Impact on riparian vegetation used for livestock and firewood.	Actions to reduce muskrat populations in the lakes, especially since there is no longer an significant economic interest. Enforce mining sites remediation to limit risks of invasive species break out.

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services	Recommendations
Mining activities	Absence of land reclamation. High number of illegal placer mining sites, causing destabilization of river banks. Destruction of riparian vegetation. Heavy metals pollution caused by recovery processes.	Potential pollution due to release of fine particles Pollution from the release of toxic substances in surface water, eventually ending up in lakes downstream and ground water.	Possible toxic effects on human and livestock health, especially if toxic substances accumulate in lakes and bioaccumulate in fish and riparian vegetation. Increase of water treatment costs for water supply	Enforce laws and improve techniques regarding land remediation Monitoring of toxic substances in sediments, and plant and fish tissues to detect polluted sites. Develop training on gravitational methods for gold recovery, to limit use of heavy metals.
Dams	Disruption of connectivity. Changes of natural flow, destruction of spawning sites downstream and upstream. Threatening environmental flow	Change of habitats distribution, especially for wetlands Impacts on natural habitats and spawning sites for fish upstream and downstream.	Impact on fish stocks. Loss of pasture area. Loss of self-purification capacity.	Modification on fishways operations to make them more efficient for the targeted species For future dams, implement sediment flushing process mimicking natural transport
Domestic uses	Household pollution in urban areas	Degradation of water quality	Impacts on water quality. Possible loss of productivity for livestock Increase of water treatment costs for water supply downstream	Implement new treatment facilities. Improve pre-treatment processes in industrial areas
Tourism	Establishment of an "eco-tourist" camps near surface water bodies Recreational fishing	Perturbations for wildlife	Loss of attractiveness for future tourist activities	Limit the number of tourist camps in the vicinity of surface water bodies. Enforce public awareness to limit perturbations (i.e. catch-and-release techniques)

Source of pressure	Type of pressure	Impacts on the ecosystems	Impacts on ecological services	Recommendations
Deforestation	Forest fires, forest pests, logging and over utilization of riparian vegetation	Destruction of riparian vegetation. Changes of river regimes Degradation of water quality (suspended solids and nutrients)	Impact on habitats for fish leading to a loss of commercial fish stocks. Loss of self-purification capacity	Improve fire protection in spring and august Improve treatments against forest pests
Crops and irrigation	Ploughing in the direction of the steepest slope Use of nutrients or pesticides	Transfer of fine particles in the streams during rain fall Risks of nutrient pollution in the future	Impact on water quality Clogging of river bed	Changes of practices, especially concerning ploughing to limit soil erosion Improving governance for irrigation activities. Maintenance of infrastructures.

9.2. Location of the main pressures

9.2.1. Groundwater

The two main issues regarding groundwater quality in Mongolia are the high mineralization and the high content of sulphate in some regions, especially in the southern part of the country (Figure 40 and Figure 41). Both can cause health problems (e.g. digestive disorders). The origin of the groundwater composition regarding minerals and sulphate is however natural, depending on the nature of the rocks of which the aquifers are composed.

Source: groundwater quality data GEI

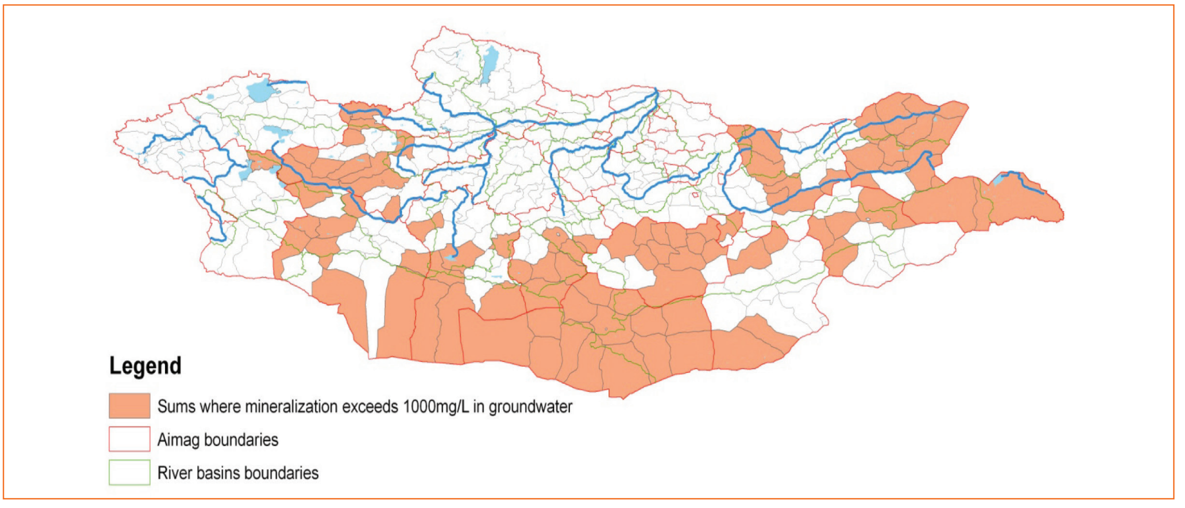

Figure 40. Soums where mineralization exceeds 1000mg/l in groundwater

Source: groundwater quality data GEI

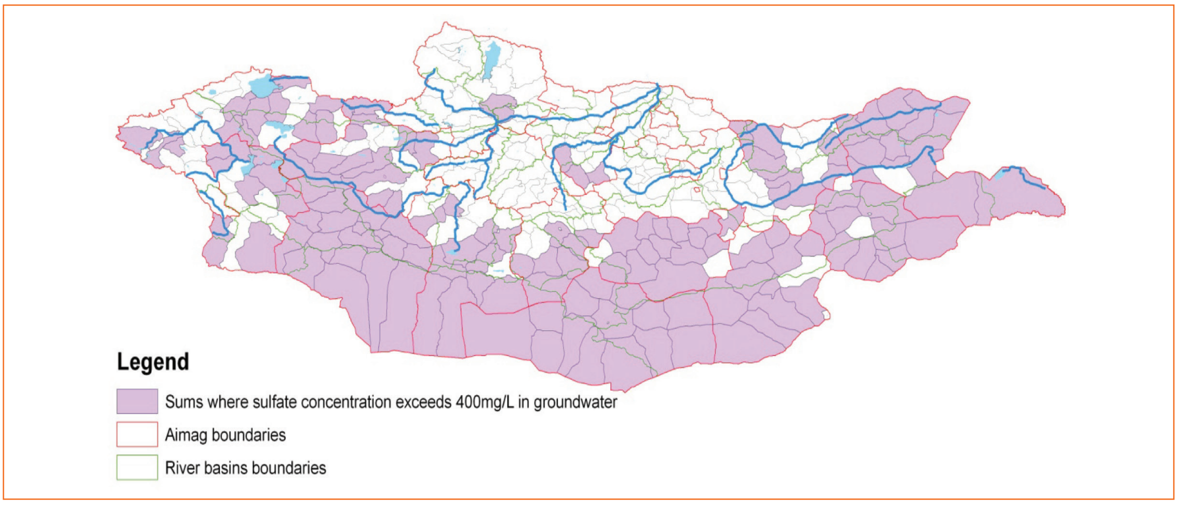

Figure 41. Soums where sulfate concentration exceeds 400mg/l in groundwater

Maps concerning the risks or occurrence of bacteriological contamination have not been done due the a lack of data.

9.2.2. Pasture degradation

Degradation of pasture is widespread (Figure 42). Pasture degradation is not necessarily due to a lack of pasture management or overgrazing from livestock, as natural conditions (e.g. drought) must also be taken into account. The decreasing number of functioning wells tends to reduce usable areas by herders and increases concentration of livestock around the surface water bodies (Table 26).

Source: National Atlas 2009

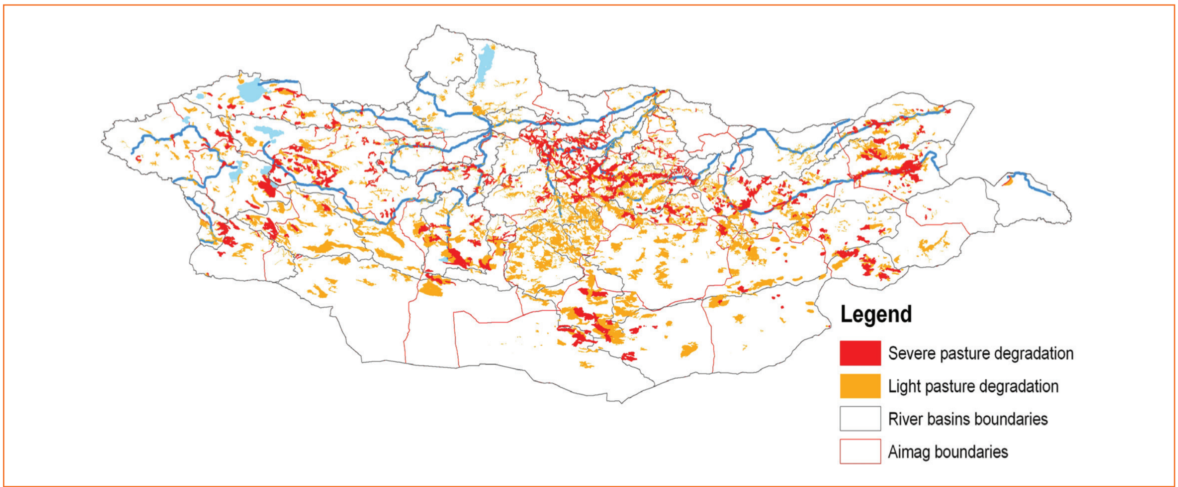

Figure 42. Pasture degradation national map

9.2.3. Fishing

Commercial fishing appears to be an issue in a few locations in Mongolia, mainly in Khar Us Nuur, Khar Nuur, Bulgan River and Buir Nuur (Figure 43).

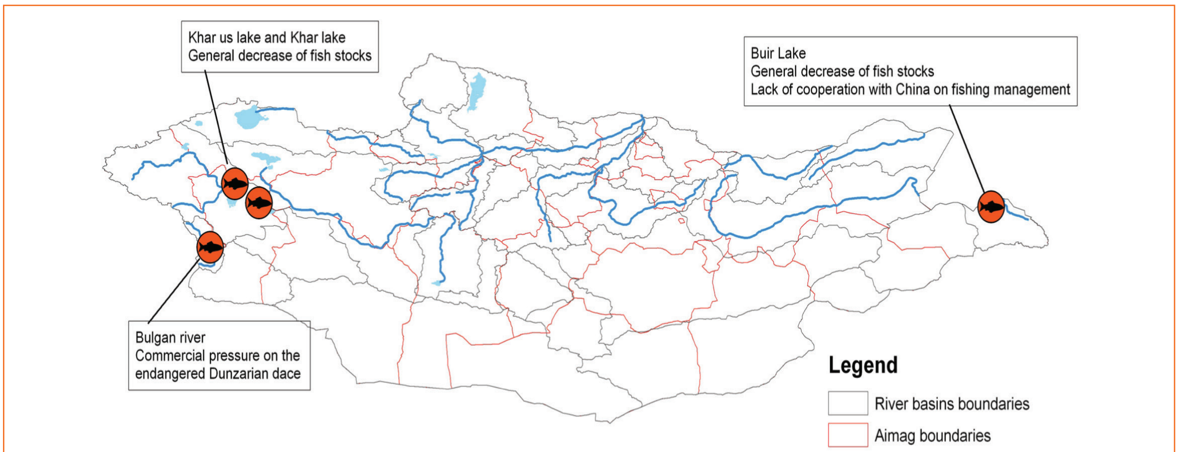

Figure 43. Location of known pressures from commercial fishing

Although a rise in commercial fishing has been reported in Khovsgol and Shishkhid river basins, too few data were available to classify this region as having pressure from commercial fishing.

The basins in the central and northern part of Mongolia suffer however from a strong pressure related to recreational fishing (Figure 44). With the increase of tourism and the accessibility to remote parts of river basins, fishing pressure increased significantly in the last decade and threatens symbolic fish species such as Taimen and Lenok. As these fish populations have a low ability to renew their specimen number, populations significantly dropped within 10 years.

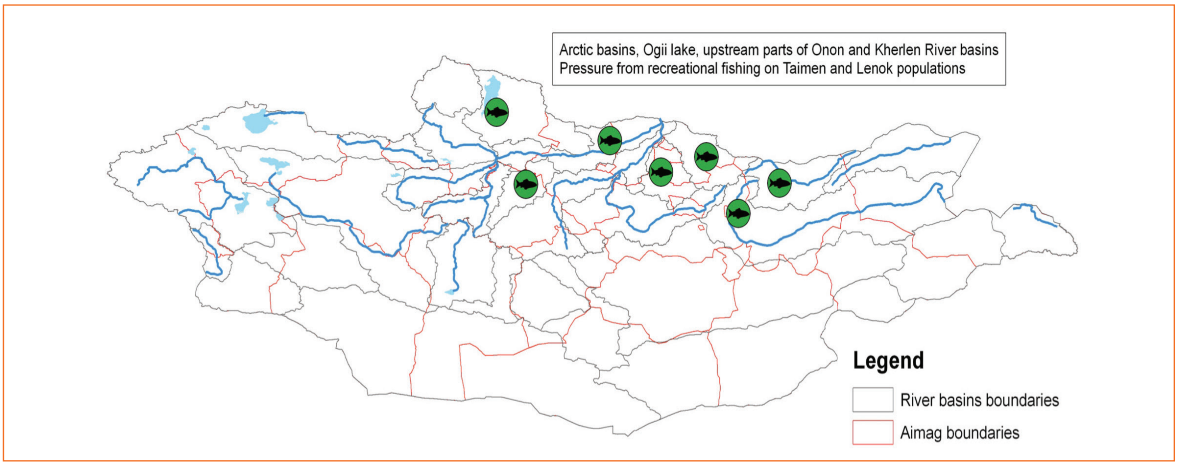

Figure 44. Location of known pressures from recreational fishing

9.2.4. Tourism (except fishing)

Apart from recreational fishing, tourism generates pressures on aquatic systems. Two sites are known to experience pressure from tourism, Ogii Lake and to a minor extent Ganga Lake (Figure 45).

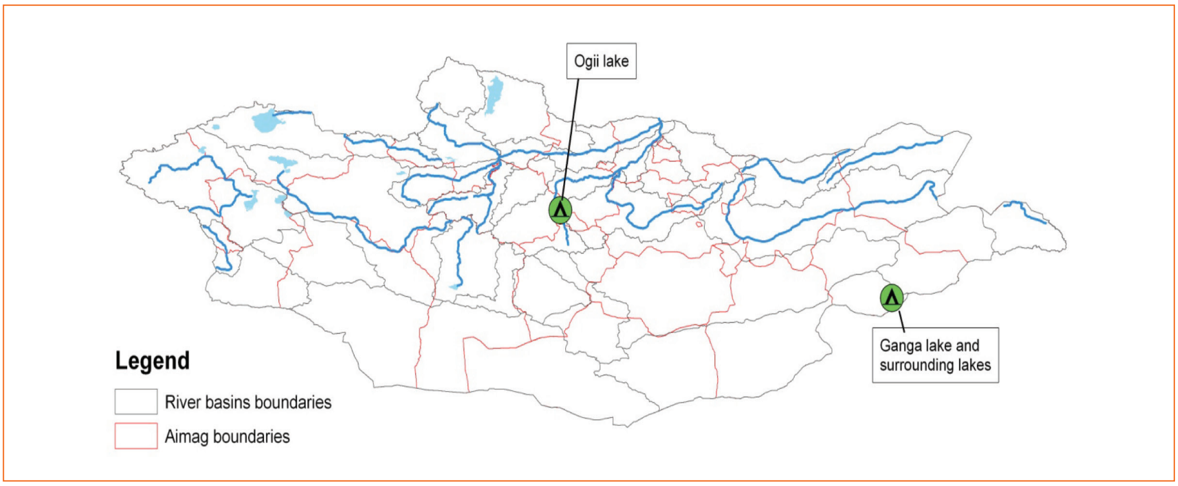

Figure 45. Location of known pressures from tourism (except recreational fishing)

Pressures consist of habitat degradation (e.g. on willow stands) and perturbations on wildlife, especially on waterbirds as migration periods trough these sites often coincide with touristic periods.

9.2.5. Mining activities

Mining activities are widespread in Mongolia. However some regions are affected more than other regions by legal or illegal mining activities, regarding mining intensity, processes used, or the vulnerability of the ecosystem (Figure 46).

The Zaamar goldfield on the Tuul River is an example of an area strongly affected by legal mining. Pressures from illegal mining are difficult to assess due to the high mobility of ninjas and the lack of information on the recovery processes used (gravitational methods or more polluting chemical methods). The infroamtion on ninja densities and locations are logically more difficult to obtain due to the illegal nature of their activities.

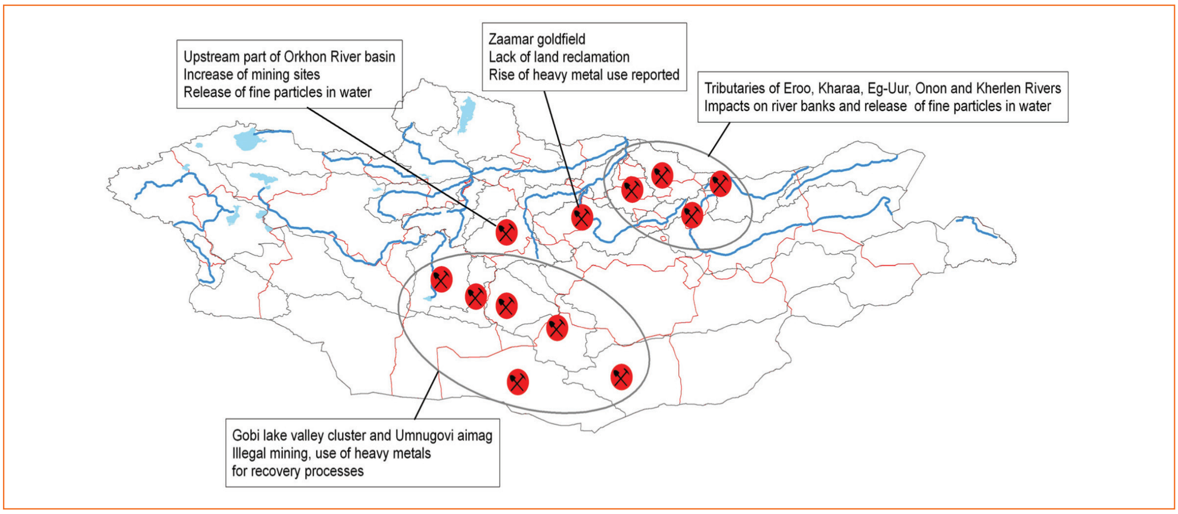

Figure 46. Location of known pressures from mining activities

9.2.6. Deforestation and loss of riparian vegetation

The loss of forest cover has various effects on the river runoff, water quality and ecology (see Table 26). Forest cover in Mongolia is affected by forest fires, inappropriate forest management (especially illegal logging and lack of forest plantation) and forest pests. The most affected areas are located in the Khentii Mountains and the Selenge and Orkhon river basins (Figure 47).

Loss of riparian vegetation is known to be an issue especially in Khar nuur-Khovd rier basin, where pressure from livestock gathering around lakes and rivers and lakes, use of wood for domestic use and the introduction of muskrat significantly impact the river banks. Pressure of livestock has also been reported to be the source of habitat degradation around Ogii Lake and Buir Lake.

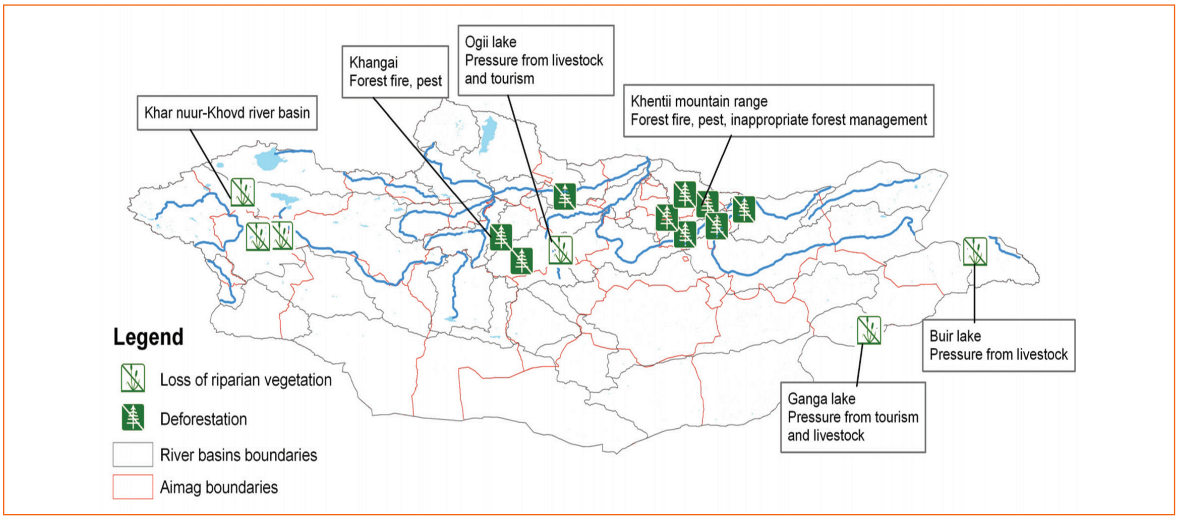

Figure 47. Location of known pressures on riparian vegetation and deforestation

9.2.7. Invasive species

The introduction of muskrats in the 70s in the western lakes in Mongolia was done for commercial purposes (fur). Business for this product stopped at the beginning of the 90s and their population rapidly developed causing destabilization of the river banks and degradation of riparian vegetation. In the Khuvsgul-Eg river basin, the introduction of Peled (*Coregonus peled*) fishes for commercial purpose generates hybridation with endemic species of coregone (*Coregonus pidschian*).

More recently, fish species introduced in China reached the downstream part of Khalkh gol river basin and might colonize the rivers of the eastern river basins (Figure 48). Impacts on ecology and on valuable fishstock are not known, but unlikely to be positive [58].

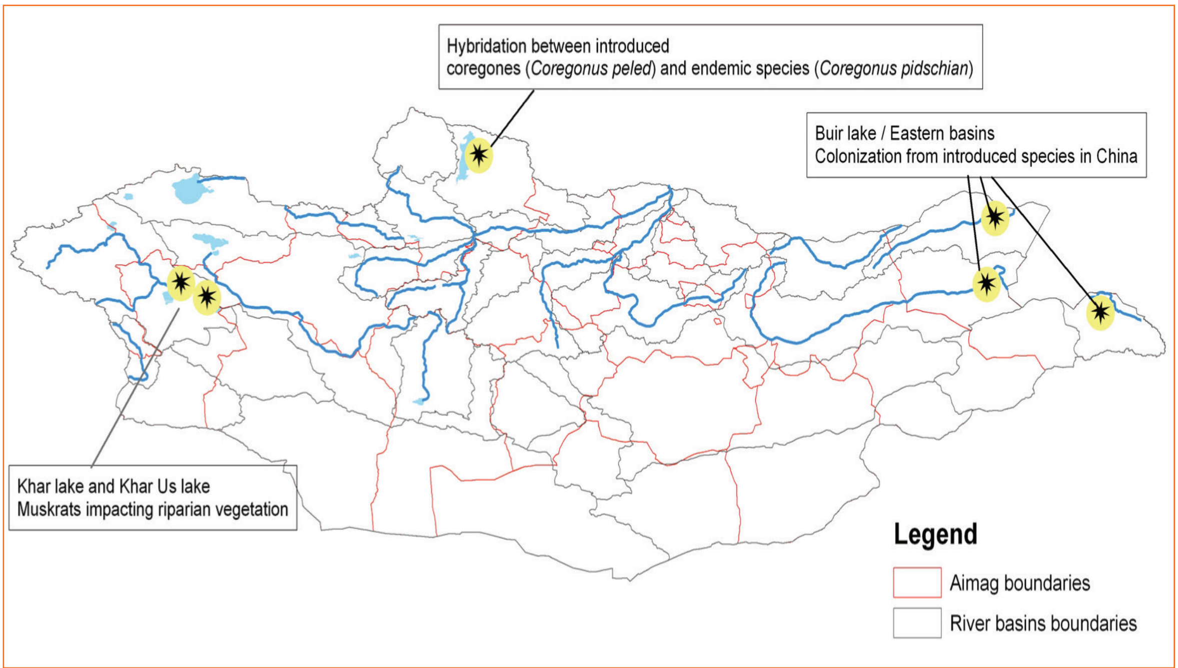

Figure 48. Locations of known pressures from invasive species

9.2.8. Dams

Dams are currently mainly concentrated in the western part of Mongolia, with only two of them located in the Arctic Ocean basin (see Figure 49). Studies on possible dam sites are concentrated in Selenge, Orkhon and Tuul river basins. As mentioned in Table 26 and paragraph 3.5.8, dams can generate a wide variety of impacts on water quality, ecosystems and uses in the floodplain upstream and downstream of the dam sites. The long term benefits and impacts of a dam should be carefully studied and evaluated before its construction. Some impacts can be mitigated in the design phase (e.g. fishway, flushing gate) other impacts can be mitigated by the management of the dam (discharge of water and sediments at critical times to reproduce the natural river runoff variability).

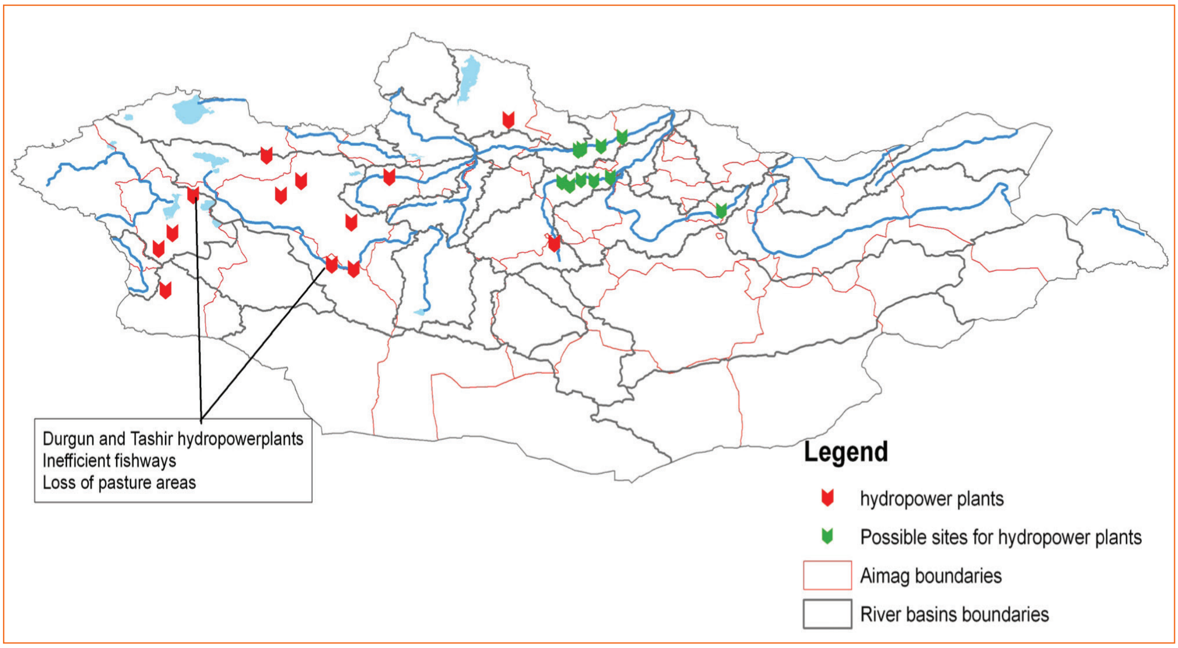

Figure 49. Locations of existing and proposed hydropower plants

10. Conclusions

Mongolia harbors pristine aquatic ecosystems, due to the low population density and previously scarce human activities spread across the country. The variety of landscapes and climatic conditions generates various ecosystems with their own characteristics and behaviour.

Surface water quality is generally good or excellent. Low mineralization, small amounts of nutrients and to a lesser extent relatively low temperatures often limit the biological productivity in the streams and the eutrophication process. This combined with essentially free flowing rivers and a natural distribution of habitats generated a specific biodiversity, with many endemic species which had to adapt to specific climatic conditions. Groundwater quality is in most cases suitable for human uses, although many aquifers located in the western and southern of the country have a high mineralization and sulphate content. These characteristics depend on the groundwater recharge frequency and the nature of the rocks and are not due to human activities. These good ecological conditions bring a valuable asset to the society, offering in most cases clean water for human uses, livestock and crops, valuable fish stocks and favoring the attractiveness of the country for tourism.

However Mongolia faces nowadays major changes regarding its land uses, migration of rural population around urban areas, and fast growing mining activities. These changes have a wide range of negative impacts on water quality and ecology. Due to the capacity of resilience of the aquatic ecosystems and their dilution capacity, many streams or aquifers are not yet significantly damaged regarding their water quality, but a tendency to degradation in every river basin is observed. If this trend continues, it will eventually end up with a long term degradation of many water resources and systems and jeopardize water uses and economic activities linked to the aquatic ecosystems.

The loss of functioning wells is a widespread issue, causing herders to concentrate in the vicinity of surface water bodies and remaining wells. More than the increase of the total livestock population, this concentration of grazing and trampling pressure significantly increases erosion and the release of fine particles in streams. Risks of pollution from bacteriological contamination in shallow aquifers can affect human health and possibly livestock productivity. Rehabilitation of wells could significantly increase available pasture area, dilute the effects of livestock on soil degradation, and lower competition for water with wildlife especially in the southern basins. Rehabilitation of wells should be accompanied by livestock number management to avoid a proportional increase of livestock pressure.

Loss of forest cover is another widespread issue affecting water quality by favoring erosion and modifying natural river regimes, mainly in the northern and central basins. Increasing tools to monitor and fight forest fires and a better forest management is required to limit ecological growing perturbations on water quality and natural river regimes.

Mining activities create degradation of water quality and river morphology and cause a loss of species and population richness especially in the river basins belonging to the Arctic Ocean drainage basins and to the Gobi lake valley cluster. Perturbations for aquatic species are local but might occur on rare spawning sites, or might block fish migration. An appropriate management of settling ponds and recovery techniques would significantly lower the impacts on water quality, while a proper enforcement of the existing laws on the rehabilitation of mining sites would limit the impacts on river morphology and the occurrence of illegal mining activities that often occur on former legal mining sites. The lack of data does not allow us to draw a clear picture on the occurrence and importance of heavy metal pollution related to mining activities. The reinforcement of local capacity to analyse samples for heavy metals is needed. Rather than investing time in patrolling, the control of the availability of mercury and arsenic should be increased to limit its uses for gold recovery.

Commercial fish catches generally decreased after the 1990s, although the number of illegal catches occurring today is hard to assess. This activity is significant in Buir lake and Khar us lake, and maybe to a lesser extent in Shishkhid and Khuvsgul-Eg river basins. Lack of management does not only affect vulnerable fish species but jeopardizes the economy linked to commercial fishing as fish population might not be renewed as immature fish are withdrawn from the lakes. Rather than a strict ban of fishing which is not implemented, public awareness and a better management of catches would allow fish population to renew itself with low impact on the local economy. Likewise, recreational fishing brings nowadays valuable economic resources but might lead to the loss of endangered and attractive species such as the Taimen in the next decade. Protection of the spawning sites, respect of the fishing period and enforcement of public awareness on catch-and-release technique is necessary to maintain attractiveness for this growing economical activity.

Crops have currently a low impact on water quality as fertilizers are seldom used. Planned development of irrigated areas seems to be mainly concentrated in Kharaa river basin, which water quality is already under the threat of various pressures. Future use of fertilizers or pesticides should be in accordance with the self-purification capacity of the river, to avoid impacts on water quality in this fragile river basin.

Construction of dams is planned especially in Orkhon and Selenge river basins, in order to answer to the energy demand. If dams can bring valuable services for water demand or energy production, it can have severe drawbacks regarding water quality and use of the floodplain on long stretches of rivers upstream and downstream. Modeling of sediment accumulation in the dam and monitoring and sediment quality should be included in the feasibility study. Heights of the projected dams are at first sight too important to install cost-effective fishways. Special attention should be paid to the discharge downstream of the dams and the occurrence of beneficial floods for pasture areas downstream.

Protected areas are covering an important part of the country, and are planned to increase. They can be useful tools to protect ecological resources however their management is reported to be unequal and often not effective. Reinforcement of staff capacities and collaboration between the local level and national agencies and institutes is needed to implement effective management plans, especially concerning activities in the buffer zones.

Mongolia faces a multitude of growing ecological issues, but many of them are very local or concern just a small fraction of the country territory. Implementation of river basins and local councils, gathering water users and environmental experts from organizations at a national level would be more effective to deal with these issues.

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Annex

Annex 1. Water quality standard: MNS 4586-98

No	Substance	Unit	Permissible
1	pH		6.5-8.5
2	DO	*mgO/l*	not less than 6and4
3	BOD	*mgO/l*	3
4	PICH	*mgO/l*	10
5	NH_4-N	*mgN/l*	0.5
6	NO_2-N	*mgN/l*	0.002
7	NO_3-N	*mgN/l*	9.0
8	PO_4-P	*mgP/l*	0.1
9	Cl-chlorine	*mg/l*	300
10	F-fluorine	*mg/l*	1.5
11	SO_4^{2-} -sulfate	*mg/l*	100
12	Mn- manganese	*mg/l*	0.1
13	Ni- nickel	*mg/l*	0.01
14	Cu- copper	*mg/l*	0.01
15	Mo- molybdenum	*mg/l*	0.25
16	Cd- cadmium	*mg/l*	0.005
17	Co- cobalt	*mg/l*	0.01
18	Pb- lead	*mg/l*	0.01
19	As- arsenic	*mg/l*	0.01
20	Cr-chromium	*mg/l*	0.05
21	Cr^{6+}	*mg/l*	0.01
22	Zn- zinc	*mg/l*	0.01
23	Hg- mercury	*mg/l*	0.1
24	Oil	*mg/l*	0.05
25	Phenol	*mg/l*	0.001
26	Active and washing substances	*mg/l*	0.1
27	Benzapyren	*Mkg/l*	0.005

Note: DO > 6 mgO/l for summer time and DO > 4mgO/l for winter time

Annex 2. Surface water quality classification

No	Classification parameters	Measurement unit	Water quality classification				
			Very fresh	Fresh	Little polluted	Polluted	Very polluted
			1	2	3	4	5
Oxygen regime parameters:							
1.	Dissolved oxygen (DO)	*mg/l*	9 <	8 <	6 <	4 <	4 <
Not concerning the definition of samples before 9 am and pm							
2.	Oxygen satisfaction	%	90 <	75 <	60 <	40 <	40 <
3.	Biochemical oxygen demand (BOD)	*mg/O_2/l*	< 3	< 5	< 10	< 15	15 <
4.	Chemical oxygen demand (COD)	-	< 10	< 15	< 25	< 50	70 <
5.	Oxidization (O_2)	-	< 3	< 5	< 10	< 20	30 <
6.	H_2S	-	Not appear	Not appear	< 0.1	< 1.0	1.0 <
Mineralization component parameters:							
7.	Total hardness	*N⁰*	< 10	< 15	< 20	< 30	40 <
8.	Calcium Ion ($Ca^{2+}Ca^{2+}$)	*mg/l*	< 45	< 90	< 150	< 200	300 <
9.	Magnum Ion ($Mg^{≥4}$)	-	< 15	< 30	< 50	< 100	200 <
10.	Dry rests of the dissolved substances	-	< 200	< 300	< 500	< 800	1200 <
11.	Chlorine Ion (Cl)	-	50	< 150	< 250	< 350	500 <
12.	Sulfur Ion (SO_4 +)		< 50	< 100	< 200	< 300	400 <
Bio pollution parameters:							
13.	Ammonium nitrogen (NH_4^+)	mg/l	< 0.02	< 0.05	< 0.1	< 0.3	0.5 <
14.	Nutrients nitrogen (NO_2^-)	-	< 0.002	< 0.005	< 0.02	< 0.05	0.1 <
15.	Nitrate nitrogen (NO_3)	-	1	< 3	< 5	< 10	20
16.	Bio nitrogen (NO_3)	-	< 0.3	< 0.5	< 1.0	< 2.0	2.0 <
Special parameters:							
17.	pH	-	6.5 8.0	6.5 8.5	6.0 8.5	6.0-9.0	5.5-9.5
18.	Total iron ($Fe^3 + Fe^{2+}$)	-	< 0.3	< 0.5	< 1.0	< 1.5	1.5 <
19.	Manganese (Mn^{2+})	-	< 0.05	< 0.1	< 0.3	< 0.8	1.5 <
20.	Phenol (C_6H_5OH)	-	Not appear	< 0.001	< 0.002	< 0.005	0.01 <
21.	Phosphate (PO_4^{3-})	-	< 0.02	< 0.05	< 0.1	< 0.5	0.5 <
22.	Total phosphorus	-	< 0.025	< 0.1	< 1.0	< 2.0	2.0 <

No	Classification parameters	Measurement unit	Water quality classification				
			Very fresh	Fresh	Little polluted	Polluted	Very polluted
			1	2	3	4	5
23.	Active washing substances in surface	-	Not appear	< 0.1	< 0.5	< 1.0	1.0 <
24.	Oil and grease	-	Not appear	< 0.05	< 0.1	< 0.3	0.5 <
25.	fats	*Quality*	-	Not appear	Not appear on the water surface		
26.	Odor and taste	*Quality and assessment*	No strange odor and taste				
27.	Color	*Quality assessment*	No color	No color	bit	Color	-
28.	Clearness	*Cm*	35 <	< 30	< 25	< 20	< 20
29.	Suspended solids	*mg/l*	< 10	< 20	< 50	< 100	100 <
	Bacteria studies parameters :						
30.	Colin titer		10 <	< 1.0	< 0.1	< 0.01	< 0.01
31.	Pathogens		None	None	None	None	None
32.	General microbial number		$< 5*10^5$	$< 10^6$	$< 3.10^6$	$< 5.10^6$	$< 5.10^6$
	Hazardous substances						
33.	Cyanide ion (CN)	*mg/l*	Not appear	Not appear	< 0.01	< 0.05	0.1 <
34.	Mercury(Hg^{2} +)	-	-	-	< 0.001	< 0.005	0.005 <
35.	Arsenic (As^{3+})	-	< 0.2	< 0.5	< 1.0	< 1.5	1.5 <
36.	Fluorine	-	< 0.2	< 0.5	< 1.0	< 1.5	1.5 <
37.	Boron (B)	-	None	-	< 0.5	< 1.0	1.0 <
38.	Selenium (Se^{2+})	-	Not appear	< 0.01	< 0.05	< 0.1	1.0 <
39.	Zinc (Zn^{2+})	-	< 0.2	< 1.0	< 2.0	< 5.0	5.0 <
40.	Tungsten (W)	-	None	None	None	< 1.0	1.0 <
41.	Copper (Cu^{2+})	-	< 0.01	< 0.05	< 0.1	< 0.5	0.5 <
42.	Cadmium (Cd^{2+})	-	Not appear	< 0.005	< 0.01	< 0.1	0.1 <
43.	Cobalt (Co^{2+})	-	0.01	< 0.02	< 0.05	< 1.0	1.0 <
44.	Molybdenum (Mo2+)	-	0.001	< 0.1	< 0.5	< 1.0	1.0 <
45.	Silver (Ag)	-	0.001	< 0.01	< 0.02	< 0.05	0.05 <
46.	Nickel (Ni^{2+})	-	0.01	0.05	0.1	0.2	0.2
47.	Sulfate	-	None	None	None	None	*
48.	Lead (Pb^{2+})	-	< 0.01	< 0.05	< 0.1	< 0.2	0.2 <
49.	Chrome (Cr^{3+})	-	None	< 0.02	< 0.1	< 0.5	0.5 <
50.	Chrome (Cr^{6+})	-	None	< 0.01	< 0.05	< 0.1	0.1 <
51.	Free Chlorine (Cl)	-	0.0	0.0	0.0	< 0.05	0.1 <
	Saprobe quality:						
52.	Pantle-Puck	-	1.0	1.5	2.0	2.5	2.5
53.	Sladchik classification	-	Kseno (KH)	Oligo (O)	Oligo -Beta - mezzo /O-? -m/	Alpha -mezo (? -m)	Poli (P)

Annex 3. Short description of some protected areas in Mongolia

From: Biodiversity Assessment and Conservation Planning, WWF (2002)

STRICTLY PROTECTED AREAS (SPA);

1. Khasagt Khairkhan

This mountain situated in Sharga, Jargalant sums territory of Gobi Altai aimag was initially protected as a strictly protected area in 1965 by PGH Presidium Resolution No. 17. It was approved as a strictly protected area in 1995 by Parliament Resolution No. 26 about 're-establishment of the state protected areas' classifications'. Its territory is 27448 hectares.

This area is a forested part of the Mongol Altai mountain range. Plants and wildlife of mountainous, steppe and Gobi regions inhabit here.

2. Bogdkhaau mountain

Bogdkhaan Mountain was officially protected, first, in 1778 by the initiative of Khuree Van Minister (a capital governor) Yundendorj, one of the leading aristocrats of that time. This mountain which is an ancient historical and cultural monument and is located near the capital was taken under protection by the PGH Presidium Resolution No. 31 of 1957 and given the name of "Choibalsan Mountain", then in 1974, it was designated as a strictly protected area by PGH Presidium Resolution No. 248 and given the name 'Bogd Uul". It occupies 41461 hectares of area. It was included in the category 'strictly protected area[1] by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas. This mountain is the southern part of Khentee mountains range, the borderline between forest steppe and steppe regions, the southern borderland of the larch forest, and is of a special significance in the climate formation of the surrounding area. Species here are characteristic of the taiga, mountain forest steppe, and steppe zone, including over 500 species of vascular plants, 9 trees, 47 mammals, 116 birds, 4 reptiles, and 2 amphibians.

Recognized as a sacred mountain, its history much related with religious civilization and settlements such as Manzchir Hiid monastery established in!750.

3. Great Gobi SPA

It was designated as a protected area in 1975 by PGH Presidium Resolution No. 84, and in 1995 it was approved as a strictly protected area by Parliament Resolution No. 26, and in accordance with the Law on Protected areas.

It consists of two parts: 'A' part includes Altai, Tsogt, Erdene sums of Gobi Altai aimag, and Bayan Ondor, Shine Jinst sums of Bayankhongor aimag; 1B' part includes Uyench, Altai sums of Khovd aimag, and Tonkhil, Bugat sums of Gobi Altai aimag; and occupies 5311730 hectares of land.

This area has kept its original conditions of Central Asian Gobi desert, and is a motherland of generally rare wildlife animals such as bactrian camel Gobi bear and Asiatic wild ass, Gobi gesco and tatar sand boa. Scientists have identified 410 species of plants, 49 species of mammals, 15 reptiles and amphibians and over 150 species in the protected area. In 1991 it was registered in the World's Man and Biosphere networks.

4. Khukh serkhyn nuruu

It occupies 65920 hectares of area of Deluun sum of Bayan-Olgii aimag and Khovd sum of Khovd aimag. It was protected by PGH Presidium Resolution No. 76 of 1977 and was approved as a strictly protected area by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas. This strictly protected area is the main habitat for argali and ibex herds, and also, is an area with a special significance in providing the ecological balance and in maintaining the original features of the Mongolian Altai mountain range.

5. Mongol Daguur

This area consists of 2 parts, where "A" part is Chuluunkhoroot sum territory of Dornod aimag and "B" part is a marginal area between Chuluunkhoroot, Gurvanzagal, and Dashbalbar sums. It was initially taken under the protection by PMH Resolution No. 11 of 1992, and then in 1995 it has been approved as a strictly protected area by Parliament Resolution No. 26. Us territory is 103016 hectares.

It contains special characteristics of wildlife, bio-diversity and geography. It was established with a purpose to protect the Daguur steppe, waters, marshes, and the world of wildlife and bio-diversity species that inhabit there. Its territory includes the strip area from the land along the Ulz river and mountain ranges along the state border till the Tari lake. This strictly protected area is a borderland between 2 kinds of larch forests which occur in Mongolia. And the larch mixed of Sibirian and Daguur larches, which is of a great biological and economic importance, grow in here. In order to protect the migrating bird species, the Russian, Chinese and Mongolian joint strictly protected area was established in 1997. Also it was registered in the list of the Ramsar convention in 1994.

6.The Eastern Mongolian steppe

This area is located in Matad, Khalkhyn gol of Dornod aimag and Erdenetsagaan sum of Sukhbaatar aimag and is the only representative of the steppe land region which has not been impacted by economic activities. In order to protect the Khyalganat steppe ecosystem and the habitation of white gazelles, this area has been taken under state special protection by PMH Resolution No. 11 of 1992 and then by Parliament Resolution No. 26 of 1995 it was included in the category 'strictly protected area'. Its territory is 570374 hectares of area around Menen steppe and Lagiin khooloi.

Over 70% of white gazelle population of Mongolia inhabit here. This area represents the steppe complexity, which has preserved its original features, of not only the Mongolian eastern steppe but also the arid steppe of the Asian continent.

7. Nomrog

This area occupies 3 11205 hectares of area along the state border in Sumber sum of Dornod aimag and in the forested steppe and steppe regions of the low, average and high mountains in the western part of Khyangan mountain range. It was taken under state special protection in 1992 by PMH Resolution No. 11 and was approved by Parliament Resolution No. 26 of 1995.

This is the only area where one can see original conditions of Khyangan mountain range, which contains the specific structure and formation of Khyangan mountainous region, and peculiarities of its transition from forest steppe into Central Asian arid steppe region. This strictly protected area has an objective to protect the ecosystem of Khyangan, and wildlife and biodiversity species of Manjuur. Regarding plants, this area has the Manjuur element which can not be found anywhere else in Mongolia.

8. Otgontenger

Otgontenger mountain, a highest peak of Khangai mountain, is situated in Otgon and Aldarkhaan sums territory of Zavkhan aimag. Historically, this mountain was initially protected in 1818. In 1992, it was taken under special protection by PMH Resolution No. 11 with a territory of 95510 hectares, and in 1995 it was approved by Parliament Resolution No. 26.

This area represents the natural complexity of Khangai mountain range and is a motherland of rare and very rare wildlife and bio-diversity species.

9. Khan Khentee Nuruu

Khan Khentee SPA, which is situated in the territory of Erdene and Mongonmort sums of Tov aimag, Batshireet and Omnodelger sums of Khentee aimag, and Eroo and Mandal sums of Selenge aimag, and occupies 1227074 hectares, was taken under special protection in 1992 by PMH Resolution No. 11. In 1995, it was included in the category 'strictly protected area' by Parliament Resolution No. 26.

Khan Khentee mountain range has preserved its original features, and is located between Eurasian coniferous forest taiga and Central Asian arid steppe. Also it feeds big rivers such as Tuul, Onon, Kherlen, Kharaa, Eroo, etc.

Khan Khentee mountain range represents basic characteristics of a natural zone, and includes 5 kinds of landscapes of real taiga. This area becomes an old historical monument of Mongolians.

10. Uvs Lake basin

This strictly protected area occupies 712545 hectares of area and consists of Uvs Lake part - located in the territory of Tes, Davst, Malchin, Naranbulag, Tarialan sums of Uvs aimag, Allan Els part - located in the territory of Baruun Turuun sum, Tsagaan Shuvuut part -located in Sagil sum territory, and Turgen Uul part -located in Turgen, Tarialan, Bokhmoron. Khovs sums territory. It was established in 1993 by Parliament Resolution No. 83.

This area is of special geographic landscape that reflects all characteristics of horizontal basin region, which does not flow outside of Central Asia. This strictly protected area consists of:

- Uvsnuur, Torkhilog, Tesiin gol adag,
- Tsagaan shuvuut,
- Altan Els,
- and Turgenii Uul, which are extremely different in terms of nature, the environment, landscapes, and are located close to each other.

11. Small Gobi SPA

This strictly protected area consists of "A" and "B" parts and occupies 1839176 hectares of land in Nomgon, Bayan-Ovoo, Khanbogd sums territory of South Gobi aimag, and Borzon, Zeemgene, Kharmagtain Gobi areas, which are the southern part of Khatanbulag sum of Dornogobi aimag. In 1993, it was established as a strictly protected area by Parliament Resolution No. 83.

This area represents main characteristics of the east-southern Gobi region of Mongolia and has relatively preserved its original natural features and conditions. It is the main habitat for rare and very rare wildlife animals of the world, such as khulan (wild ass), black-tailed gazelle, argali (mountain sheep), and ibex. About 50% of the khulan population of our country occur in this area.

12. Khordol Sardag Nuruu

This area covers the territory of Ulaan-uul, Renchinlkhumbe sums of Khovsgoi aimag and occupies 188634 hectares of land. It was taken under state special protection in 1997 by Parliament Resolution No. 47.

It has characteristics of horizontal region, such as tundra, taiga, forested steppe and mountainous area, which are greatly different in terms of nature, the environment and landscape, but are located close to each other. Due to this characteristic, it becomes the habitation of many bio-diversity species of tundra soil, which have become rare and very rare, (S.involucrata, A. altaicum Pall, etc), and wildlife species (argali, ibex, sibirian moose, snowcock, sable, etc). There is a part of argali and ibex population occur in here, which is an unusual thing.

THE NATIONAL PARKS (NP):

l.Khorgo-Terkhiin Tsagaan Nuur

This beautiful place, which is located in Taryat sum territory of Arkhangai aimag, was taken under protection by PGH Presidium Resolution No. 17 of 1965, and by Parliament Resolution No. 27 of 1995, the area comprising 77,267 hectares of land was designated as a national park, in accordance with the Law on Protected Areas.

This area is of special formation, such as rocks created due to volcano eruption.

2. Khovsgoi

This national park comprises of the territories of Alag-Erdene, Renchinlkhumbe, Tsagaan Uul, Khankh and Chandmani-Ondor sums of Khovsgoi aimag. This NP covering 838,070 hectares was taken under special protection in 1992 by PMH Resolution No. 11 and was classified as a NP by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas.

It has been purposed to represent the taiga regional complexity, to protect the Khovsgoi lake basin, to develop the eco-tourism, and to conduct surveys and studies.

3. Gobi Gurvansaikhan

The Yolyn Am was initially protected in 1965 by PGH Presidium Resolution No. 17, and then in 1993 by Parliament Resolution No. 83, its territory was extended by further including the territories of Sevrei, Bayandalai, Bulgan, Khankhongor, Khurmen, Gurvantes sums of South Gobi aimag, which comprise 2171737 hectares of area, and was approved as a national park. By Parliament Resolution No. 26 of 1995, it was approved.

It can represent main natural characteristics of Gobi-Altai mountain range. It has various landscapes, such as high mountains, mountain valleys, arid steppe and desert. The main orientation is to carry out tourism activities in Gobi regions through the sustainable way .

4. Gorkhi-Terelj

This NP comprises 293,168 hectares of area of Erdene sum, Tov aimag. It was formed in 1995 by Parliament Resolution No. 83.

It can represent the south complex of Small Khentee mountain and is suitable for managing tourism activities.

5. Khustain Nuruu

This area was established as a nature reserve by Parliament Resolution No. 83 of 1993, and as a national park by Parliament Resolution No. 115. Its territory comprises of 49940 hectares land of Altanbulag, Argalant, Bayankhangai sums of Tov aimag.

This area represents characteristics of steppe regions of the west-southern part of Khentee mountain range. Due to its sufficiency of fodder and water resources, as well as geographical suitability, the takhi (wild horses) from the Takhi Protection Foundation of Holland and Askani-Nova of Ukraina are re-introduced in this area.

6. *Altai Tavan Bogd*

This area has a territory of 636161 hectares along the border of the western part of Ulaan Khus, Tsengel, Sagsai, Altai sums of Bayan-Olgii aimag. It was taken under protection in 1996 by Parliament Resolution No. 43.

This National park has beautiful nature and represents special characteristics of high mountainous, icy rivers, mountain valleys, steppe landscapes and ecosystems. Also, it is a habitat for mammals, like argali, ibex, maral, deer, and bird species, like snowcock, eagle, lammergeyer.

This area is suitable for developing mountain sport and eco-tourism.

7. *Khangain Nuruu*

This area comprises of the central part of Khangai mountain range which is a border crossing area between Chuluut, Bulgan, Tsenkher, Khotont, Ikh Tamirof Arkhangai aimag, Kharkhorin, Khujirt, Bat-Olzii, Uyanga sums of Ovorkhangai aimag, and Erdenentsogt, Galuut sums of Bayankhongor aimag. It was taken under protection in 1996 by Parliament Resolution No. 43 and covers 888,455 hectares of land.

This area has kept original features of its natural complexity of Khangai mountain, and is a composition of an amazing mixture of natural landscapes. It is a partition of the world's watershed. Also, it is of a special significance in the water and climate change in Mongolia, and in maintaining ecological balance.

8. *Khar Us Nuur*

This area comprises of 850272 hectares of Myangad, Dorgon, Chandmani, Mankhan, Buyant sums of Khovd aimag. By Parliament Resolution No. 47 of 1997, it was designated as a national park.

This NP is located near Ikh Nuuruud lowland covering a large area of desert steppe and arid semi-desert environment, and plays a decisive role in the climate formation and composes a special ecologic environment. It is a habitation of rare and very rare wildlife species. Also, it is the unique natural place which is composed of mountains with fresh water resources of our country, Gobi desert, steppe valleys, and the Mongolian Altai Mountains covered with snow.

This NP was registered in the list of the Ramsar Convention in 1999 due to its suitable environment for water and marsh bird species to live.

9. *Noyonkhangai*

This NP with a territory of 59,088 hectares of Khagain sum of Arkhangai aimag was established by Parliament Resolution No. 28 of 1998.

This area is a special and beautiful formation of nature and is a habitation of many rare and very rare wildlife and bio-diversity species. There are many mineral waters and springs. Since ancient time, there has been followed a historical tradition to worship this area.

NATURE RESERVES (NR):

1. Batkhaan

It was initially protected by PGH Presidium's Decree in 1957. This area is located in Burd sum territory of Ovorkhangai aimag and Erdenesant sum of Tov aimag. It was designated as a nature reserve comprising 58800 hectares by Parliament Resolution No. 26 of 1995, in accordance with the Law on Protected Areas.

It is a component of the Khangai and Khentee mountainous state and is an ancient historical and cultural monument.

2. Nagalkhaan Uul

It was initially protected in 1957. According to the new law on Protected Areas and by Resolution No. 26, this area was designated as a nature reserve. It is located in Erdene sum territory of Tov aimag covering 3076 hectares of land.

It is the southernmost part of Khentee mountain range and the pine forest.

3. Bulgan gol

The area, a strip of land with beaver between Bulgan sum territory and Bulgan river of Khovd aimag, was initially designated as a protected area by PGH Presidium Resolution No. 17 in 1965. In 1995, it was included in the classification "nature reserve" with the territory 1,840 hectares by Parliament Resolution No. 26, in accordance with the law on Protected Areas.

There many various wildlife species inhabit in this area. The very rare wildlife species such as beaver, black sable with silver tip, stone marten, Mongolian agama, etc occur here. This NR is purposed to study and to breed beavers.

4. Lkhachinvandad Uul

It is located 75 km to the south from Erdenetsagaan sum center of Sukhbaatar aimag. By PGH Presidium Resolution No. 17 of 1965, the area of 750 sq. km was initially designated as a protected area. In 1995, this area was included in the classification "nature reserve" with territory 58500 hectares by Parliament Resolution No. 26, in accordance with the law on protected areas.

This area is a habitation of mountain deer, and is a mountain steppe with no forest. There grow many species of steppe bio-diversity.

5. Ugtam Uul

This low mountain, which continues from the west-south to the east-north and along the Ulz river in Dashbalbar and Bayandun sums territory of Domod aimag, was taken under special protection by Parliament Resolution No. 83 of 1993.

It is a beautiful place located in the frontier area between forest steppe and steppe regions, and can represent the natural complexity. It is specific that the Dornod part forest border is pushed in to the south.

6. Sharga-Mankhan

It consists of 2 parts, one of which is Mankhan part located in Buyant, Mankhan sums territory of Khovd aimag, and the other one is Sharga part located in Tonkhil, Darvi, Togrog, Khaliun sums territory of Gobi-Altai aimag. The distance between these two parts is about 200 km. It was approved by Parliament Resolution No. 83 of 1993 with the territory 390071 hectares. It is the last origin place of the Mongolian antelope, one of two antelope sub-species that exist on the world. Therefore, this NR is purposed to protect and to breed antelopes.

7. Alag Khairkhan

It comprises of 36400 hectares of Bugat sum territory of Gobi-Altai aimag. This area was taken under special protection in 1996 by Parliament Resolution No. 43.

It is one of the high mountains of the middle part of Mongol Altai mountain range, and is a habitation of rare and very rare bio-diversity species (S. involucrata; serjmyadag; D. superbus), and wildlife species (argali, ibex, snow leopard, and snowcock).

8. Burkhan Buudai

The Burkhan Buudai Nature reserve covers 52110 hectares of land in the marginal area between Biger, Tsogt and Khaliun sums of Gobi-Altai aimag. In 1996 it was taken under special protection by Parliament Resolution No. 43.

Many small local rivers take sources from here. There are many naturally created special places. Local people have been worshipping the brown stone which is located at the top of low bogd mountain and looks like a wheat.

9. Ikh Nart

The Ikh Nart nature reserve, which covers 43740 hectares of land between Dalanjargalan and Airag sums of Dornogobi aimag, was established in 1996 by Parliament Resolution No. 43. Because it is the east-northernmost part of argali habitation, it was purposed to extend the argali distribution and to protect the special formation of nature and the environment.

10. Zagiin Us

This nature reserve covers 273606 hectares of land between Olziit sum of Dundgobi aimag, Mandakh sum of Dornogobi aimag and Manlai sum of South Gobi aimag.

The Zagiin Us valley is a mixture of saline soil, dry circular salt marsh, saxaul forest and sand dunes. It creates multilateral landscape conditions and ecological special environment. Also, it is the east-northern part of the saxaul forest distribution, the northernmost part of the black-tailed gazelle distribution, and the western part of the white gazelle distribution.

11. Ergeliin Zoo

The area, which covers 60910 hectares of land of Khatanbulag sum of Dornogobi aimag, has a special formation of nature and is abundant in archeo-logical findings, was included in the category "nature reserve" and taken under state special protection by Parliament Resolution No. 43 of 1996.

This place has kept the findings of the mammal animals which become the witnesses of the biological kingdom for over 30 million years ago. Many scientists have been studying this area and it has been recorded as "Altan Uul" in foreign books and magazines.

12. Khognokhaan

It covers 46990 hectares of land and is situated in Gurvanbulag, Dashinchilen, Rashaant sums of Bulgan aimag. This area was taken under state special protection in 1997 by Parliament Resolution No. 47.

It is specific that there grow taiga and steppe plants, at the same time. Also, it is specific that there are 2-3 different natural zones happened upon at the same place. There grow C. mongolicus Pojark which is famous as "Khogno, Tarnyn" within population.

13. Toson khulstai

This area occupies 469928 hectares of land of Bayan-Ovoo, Norovlin sums of Khentee aimag, and Kholonbuir, Tsagaan-Ovoo sums of Dornod aimag. It was approved in 1998 by Parliament Resolution No. 28.

Toson, Khulstai nuur, Salbaryn valley are the main habitats for white gazelles, and, with regard to this, it was purposed to extend the distribution of white gazelles to the north from the Kherlen river.

14. Khar Yamaat

This area occupies the territory of 50594 hectares of Bayan Ovoo sum of Khentee aimag and Tumentsogt sum of Sukhbaatar aimag. It was approved by Parliament Resolution No. 28 of 1999.

The surrounding area of Khar Yamaat and Turuu Ondor mountain has a special formation, which rarely occur in the steppe region, and is an ending continuation of Khan Khentee mountain range. This place is called "Khangai" and is apart of area, where grow pine and aspen groves, fruits and medicinal plants.

15.Yakhi Nuur

It was established by Parliament Resolution No. 28 of 1998, with an area of 251388 hectares between Sergelen, Gurvanzagal, Choibalsan sums of Dornod aimag.

It is the northernmost part of the white gazelle distribution, and is one of the main habitats for the migrating birds.

NATURAL HISTORICAL MONUMENTS (NM):

l. Bulgan Uul

This area was initially protected by PGH Presidium Resolution No. 17 of 1965 and, then in 1995, it was included in the category "monument" by Parliament Resolution No. 26 of 1995.

It occupies 1840 hectares of area of Tsetserleg sum of Arkhangai aimag. It is included in the mountainous belt with an atriat formation of the Mongol and Amar lake valleys and creates a special local micro-climate. This area is suitable for re-introducing sables.

2. Uran-Togoo-Tulga Uul

It is situated in Khutag-ondor sum territory of Bulgan aimag. This beautiful mountain was initially protected in 1965 by PGK Resolution No. 17, and then, in 1995 it was designated as a monument by Parliament Resolution No. 26. It covers 5800 hectares of area and is an inactive volcano with special nature formation.

3. Khuisiin naiman nuur

The area, which covers 11500 hectares around the lake located in the Uyanga sum territory of Ovorkhangai aimag to the west-south from Khangai mountain range and its surrounding area, was taken under state special protection by PMH Resolution No. 11 of 1992, and was included in the category "monument" by Parliament Resolution No. 26 of 1995.

It has a special formation and beautiful nature in the middle part of Khangai mountain range. Also, it is a valuable monument for geological and water studies. These lakes with fresh water and interconnected by the ground water channels such as Shireet, Khaliut, Bugat, Khaya, Khuis, Onon, Doroo, Bayan-UuI, are called Khuisiin Naiman Nuur (Khuisiin Eight Lakes).

4. *Eej Khairkhan Uul*

It is located between Tsogt and Altai sums of Gobi-Altai aimag, the west-southern part of Mongolia. This area was protected in 1992 by MK Resolution No. 11, and in 1995, was included in the category "monument" with the territory 22475 hectares by Parliament Resolution No. 26 of 1995.

The 9 green-framed stone pots which are set aside the deep rocky strip near the solitary mountain which is cut off the Gobi Middle Mountains, and in the western side of Eej Khairkhan mountain, very much attract the interests of nature lovers and conservators. When the first pot is filled up, it creates a little waterfall by pouring the excessive water to the next pot through the stone threshold which is 40-50 cm long.

5. *Ganga Nuur*

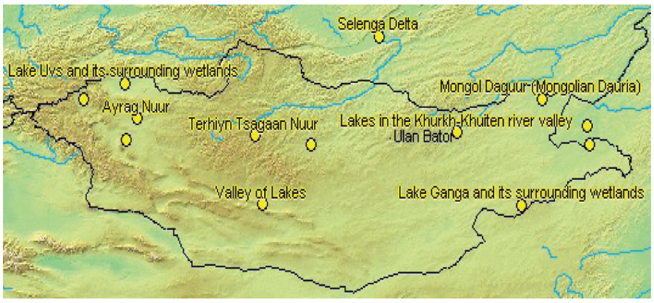
The area" surrounding the lake which was formed by the sand block created by the wind movement, with a territory 32860 hectares was designated as a monument by Parliament Resolution No. 83 of 1993. It's a beautiful lake with fresh water and is located between the mountainous steppe and Gobi regions. It composes the special local climate.

6. *Suikhent*

This area covers 4830 hectares of Mandakh sum territory of Dornogobi aimag. It was taken under protection by Parliament Resolution No. 43 of 1996.

This area has a rare natural formation with petrified trees which does not often occur in Mongolia.

RAMSAR SITES OF MONGOLIA



Source of map: http://ramsar.wetlands.org (database)

Ayrag Nuur	*13/04/99*	Hovd Province	45,000 ha	48ɵ53′N 093ɵ25′E
Har Us Nuur National Park	*13/04/99*	Hovd Province	321,360 ha	47ɵ58′N 092ɵ50′E
Lake Achit and its surrounding wetlands	*22/03/04*	Bayan-Ulgii, Uvs Provinces	73,730 ha	49°40′N 090°35′E
Lake Buir and its surrounding wetlands	*22/03/04*	Dornod Province	104,000 ha	47°48′N 117°40′E
Lake Ganga and its surrounding wetlands	*22/03/04*	Sukhbaatar Province	3,280 ha	45°15′N 114°00′E
Lake Uvs and its surrounding wetlands	*22/03/04*	Uvs Province	585,000 ha	50°20′N 092°45′E
Lakes in the Khurkh-Khuiten Valley	*22/03/04*	Khentii Province	42,940 ha	48°18′N 110°34′E
Mongol Daguur (Mongolian Dauria)	*08/12/97*	Dornod Province	210,000 ha	49ɵ42′N 115ɵ06′E
Ogii Nuur	*06/07/98*		2,510 ha	47ɵ46′N 102ɵ46′E
Terhiyn Tsagaan Nuur	*06/07/98*	Arkhangai Province	6,110 ha	48ɵ10′N 099ɵ43′E
Valley of Lakes (Boon Tsagaan Nuur, Taatsiin Tsagaan Nuur, Adgiin Tasgaan Nuur, Orog Nuur)	*06/07/98*	Bayankhongor Province	45,600 ha	45ɵ19′N 099ɵ58′E

Ayrag Nuur. A shallow, freshwater lake in the Mongolian Great Lakes Basin. An exceptionally important breeding and resting site for a variety of waterbirds and the only remaining place in Mongolia where the Dalmatian Pelican regularly comes to breed. The lake is of fundamental importance for the groundwater recharge of the area.

Har Us Nuur National Park. Three large but shallow lakes - Har Us Nuur, Har Nuur and Dorgon Nuur. Vast reedbeds and extensive aquatic plant communities provide a suitable habitat for a large number of breeding and migratory waterbirds. The lakes are of fundamental importance for the groundwater recharge of the area, and are of social and cultural significance because of the presence of a number of sacred places and archeological sites.

Lake Achit and its surrounding wetlands. Freshwater shallow lakes in the Khovd River basin, with the Achit Lake being the largest in the Mongolian Altai range. The site, lying in an intermountain basin at 1435m, includes Devel State Nature Reserve to the south (1,030ha). Lakes are frozen from November to May.

Lake Buir and its surrounding wetlands. The largest freshwater lake in eastern Mongolia, part of the basin of the large Amur River, together with many associated small lakes - northeastern parts of the system outside the Ramsar Site boundary lie across the border with China. This transitional habitat between Daguur and Stipa steppes features flora and fauna characteristic of arid steppe; it regulates the Khalk gol River and the Buir lake's water regime and protects the origins of many small rivers, lakes, streams, and springs.

Lake Ganga and its surrounding wetlands. Natural Monument Area. A small brackish lake (220ha) and associated lakes in eastern Mongolia within a unique landscape combining wetlands, steppe and sand dunes, located in the strip between the south steppe and Gobi zones. This lake district is based in the wind-scoured lowlands of extinct volcanoes and known as Dariganga.

Lake Uvs and its surrounding wetlands. UNESCO Biosphere Reserve. The largest saline lake in Mongolia with a small part lying in Russia, a unique wetland in desert-steppe landscape fringed by high mountain ranges; it has a maximum depth of 20m and freezes over from November to May.

Lakes in the Khurkh-Khuiten river valley. Permanent lakes located in the transition zone between Mongolian forest and steppe zones in the basin of the Khurkh-Khuiten River, a tributary to the great Onon River.

Mongol Daguur (Mongolian Dauria). Set in a basin formed by tectonic and volcanic activity, the site includes vast steppes, marshy wetlands, rivers and lakes. Supports a high species diversity with many endemic or rare plants. Semi-nomadic, animal husbandry is the principal livelihood of the local population. Crop production is also practiced.

Ogii Nuur. A freshwater lake located in the valley of the Orkhon River, comprising extensive alluvial areas of grassland, river channels, pools and marshes surrounded by grassy steppe. The maximum depth of the lake is 16 meters, but about 40% of the lake is less than 3m deep. The lake supports an intensive fishery and livestock grazing. It is a very important breeding and staging area for a wide variety of waterfowl.

Terhiyn Tsagaan Nuur. A freshwater and nutrient-poor lake formed by volcanic activity, located in the Suman River valley in the Central Khangai Mountains. As with most wetlands in Mongolia, land use in and around the lake is restricted to fishing and livestock grazing. The extensive marshes in the west are an important breeding and staging area for migratory waterfowl.

Valley of Lakes (Boon Tsagaan Nuur, Taatsiin Tsagaan Nuur, Adgiin Tasgaan Nuur, Orog Nuur). A chain of four saline lakes at the foot of the Gobi Altai, ranging from 1100m to 1235m in altitude. The lakes are shallow, with a saucer-shaped depth profile, and vary considerably in size both seasonally and from year to year. These lakes are known to be an important staging area for migratory waterfowl, and it has been suggested that they might be a breeding area for the rare Relict Gull. The lakes provide grazing land for domestic livestock in an otherwise arid region.

PART 4.
WATER SUPPLY, HYDRO CONSTRUCTIONS, WATER USE AND WATER DEMAND

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[1] *"Strengthening integrated water resources management in Mongolia" project*

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Introduction

Demand for fresh water is increasing along with the rapid development of the country's society and economy. Using water resources wisely is the urgent problem of our country and the whole world.

As of 2010, one person uses 230 liter of water daily who lives in the cities with hot water supply including Ulaanbaatar, Darkhan, Erdenet and Choibalsan. It is close to the average world use. The ger district person who has no connection to the centralized pipelines uses 6-9 liter of water per day. In the countryside, people use less water than this.

The fresh water demand is increasing and water supply networks are expanding from year to year due to the growth of population and industries.

The water resources are always renewed but they have limits. It is important to use the water resources wisely and protect them from pollution in order to support a stable socio-economic development and a healthy state of the river basin ecosystems.

Ulaanbaatar city is located in the Tuul river basin. For the last two decades, the concentration of people and industries was enlarged and water demand-use increased along with it. Negative impacts of business activities on the surrounding environment increased, such as loss of water regime, water scarcity and pollution of water resources. Also in the low-water-resources areas of South Gobi water demand will increase due to the development of the big mineral deposits at Tavan Tolgoi, Oyu Tolgoi and Tsagaan Suvarga.

It is necessary to deal with the above mentioned issues related to water in an integrated way. In this report, the following is included: water use, water consumption, and water supply and hydro constructions issues. Based on the collected data and information, the current situation of water demand and use is presented for the years 2008 and 2010. Its future perspective (water demand) is included for the years 2015 and 2021 corresponding to the periods used in policy documents approved by the Government of Mongolia. The demand was calculated using high, medium and low scenarios by taking into account socio-economic growth and decline.

This report will act as basic research material for the development of the national, Orkhon and Tuul river basin integrated water resources management plans.

Previously conducted research indicated that 20 percent of our country's water use is from surface water resources and 80 percent is from groundwater resources. Our country's water resources use management's main objective is to rationalize this ratio.

As for drinking water supply, Ulaanbaatar, aimag centers and other cities are included in urban water supply and soums, bag centers and rural areas are included in rural area water supply.

The following is included in the water supply chapter of the report: current situation of water supply, drinking water quality and protection, water supply efficiency, water supply expansion, plan for improvement and brief conclusion.

When estimating water demand and use as well as its future perspective, they are categorized and estimated as follows: urban and rural population drinking water supply; industrial and power plants' water supply; mining water supply; agricultural (livestock and farming) water supply and tourism and green areas water supply. The results of the calculation of the water use and the water demand for each aimag, each river basin and Ulaanbaatar city are included in separate Annexes at the back of this report.

1. Data and Information Used

1.1. Existing data and their sources

Data and information used for this report are presented in Table 1 and reports that are developed within the framework of "Strengthening Integrated Water Resources Management in Mongolia" project are presented in Table 2.

Table 1. Data source used

Data type	Data source	Description
Population	NSO Statistical yearbooks	Urban and rural population per soum
Drinking water supply coverage	NSO, MRTCUD, PUSO's	Percentages are indicative because different sources provide varying values
Population drinking water norms	MNET	Order N153 of the Minister of Nature and Environment, 1995
Actual drinking water consumption	USUG, PUSO's	Actual data as of 2008 and 2010 demand
Data urban water supplies	PUSO, USUG	Some data from Municipal Office of Ulaanbaatar and aimag's Governor's Office
Data rural water supplies	MFALI	Soum and district water supply data from aimags and soums
Data municipal water supply and water consumption	Aimag Governor's Office and Municipal Office of Ulaanbaatar	Data is from Ulaanbaatar, aimags, soums and districts
Drinking water quality	MOH, PHI	Information from publications and presentations
Data industrial water supply and water use	WA, MRA, MFALI	Information obtained directly and obtained from publications and presentations and consultant reports
Data agricultural water supply and water use	MFALI	Information obtained directly from MFALI publications and presentations
Tourist water use	NSO	Visiting tourist numbers are taken from NSO data
Green areas	Aimags, MNET, MFALI	Information obtained directly from relevant organizations
Roads and transport	MRTCUD	Information obtained directly from MRTCUD
Flood protection	MRTCUD, municipalities	Information obtained directly from Ulaanbaatar and aimags' relevant organizations
Dams and weirs	MFALI	Data on irrigation from MFALI and data on hydropower plants from MNEE

Table 2. Project reports

Report name	Author	Organization	Year	Short description
Analyze Report of State Policy in the Road, Transport and Urban Development Sector Water Supply	O.Tsedendamba	Administration of Land Affairs, Construction, Geodesy and Cartography	February 2011	Report describing policy, project implementation, future trend in the Road, Transport and Urban Development Sector
Water Supply Related Policies , Analysis in the Food, Agriculture and Light Industry Sector	G.Davaadorj	Swiss Development Agency's Desertification Decentralization Project	February 2011	Implementation of project and program in the Food, Agriculture, and Light Industry Sector; their future trends
Water Supply, Waste Water Treatment & Sanitation Report	Twan van der Mierde	Royal Haskoning	June 2010	International consultant final report on water supply, waste water treatment and sanitation

Report name	Author	Organization	Year	Short description
Report on Water Supply	B.Sukhbaatar	Water Center	September 2010	Report of water supply consultant; (Appropriate Use of Water and Reduction of Water Losses)
Hydraulic Structures in Mongolia	Ts.Batdorj	"Monhydro construction" Co. ltd.	2007	Report of hydraulic structures consultant
Population water supply and sanitation management in Mongolia	S.Chuluunhuyag	Mongolian University of Science and Technology	2007	Drinking water supply consultant report
Agricultural water supply management in Mongolia	L.Janchivdorj	Geo-ecology institute	2007	Agricultural water supply report
Industrial water supply management in Mongolia	D.Basandorj	Mongolian University of Science and Technology	2007	Industrial water supply consultant report
Mining industrial water supply management in Mongolia	U.Borchuluun	MNEE	2007, 2010	Mining water supply consultant report

Remark: Additional reports used are also included in the list of references at the end of the report.

1.2. Methodology

This chapter describes the methodologies used in collecting information on water supply and hydro constructions and the methodologies used to calculate water consumption, water use, water demand and future trends.

1.2.1. Water Supply

The water supply is categorized into the following sectors:

- drinking water supply for urban and rural population;
- drinking water supply for municipal services;
- industrial (food industries, light industries, heavy industries, energy, construction and construction material);
- mining;
- agriculture (irrigation and livestock);
- tourism and
- green areas.

The supply of heated water by power stations is included as part of the industrial water supply. Much water is used by hydropower plants. It is not included in the water use calculation because there is not much change for the water used in terms of volume and quality.

For each type of water supply information is collected on:

- the past, current and future lay-out of the abstraction and distribution system;
- the trend in the number and type of consumers and users;
- the past, current and future water consumption norm.
- Population drinking water supply

Urban population drinking water supply: it includes supply to city centers, ger districts, satellite cities and new urban settlement zones.

The information on urban water supplies is obtained from aimag public companies and organisations (USUG) responsible for the abstraction and distribution of the water in the urban centers. Urban population consumption water is classified and distributed as drinking, hot and cold as well as heating.

Information is collected on:

- Lay-out and properties of the abstraction and distribution system
- Number and type of consumers and users
- Water consumption norm

Rural population drinking water supply: It includes supply to soum centers and rural (herders and farmers) population.

There are no boreholes designed specifically for rural population drinking water as boreholes are drilled for the purpose of livestock watering in order to use pasture. The information on pasture wells, water points, number and type of water consumers and water demand norm is obtained from the WA and MFALI.

Agricultural water supply:

Livestock: The information on livestock water supplies is obtained from the WA and MFALI.

Information is collected on:

- The type of wells used in the livestock water supplies
- The number of livestock water supplies
- The number of livestock
- Water consumption norm

Irrigation: The information on irrigation water supplies is obtained from MFALI.

Information is collected on:

- The number, type and capacity of the irrigation systems
- Crop water requirements

The conclusion summarizes the status and the issues and possible measures regarding the agricultural water supplies.

Industrial water supply

The information on industrial water supply is obtained from WA and other relevant sources. The information is collected on type of water use and water sources.

Briefly mentioned in the report are: reuse of industrial waste water, improved efficiency of water use, recommendations to improve water supply, Orkhon-Gobi and Kherlen-Gobi projects to improve mining water supply of southern Gobi.

Tourist camps water supplies

The information on tourist camp water supplies is obtained from MNET. The water consumption of this category is small but should be included in the overview of water supplies.

Green areas water supplies

The information on green areas water supplies is obtained from the WA and municipalities. The water consumption of this category is small but should be included in the overview of water supplies.

1.2.2. Sectors' water consumption and water use

In this report, water consumption and water use of 2008 and 2010 are classified by each sector and consumption and use are estimated by each aimag, soum and basin.

A. Population drinking water consumption

a) *urban population*

- apartments; ger districts; satellite town, new settlement zone

b) *rural population*

- soum center; rural area (herders, farmers)

B. Municipal services water consumption and water use

a) *Public services water consumption*

- offices (administrative and entity offices), hospital, school, kindergarten, nursing school, cultural center, protection and education entity (organization), children's camp, pre-detention and rehabilitation center , military units

b) *Commercial services water use*

- fountain, pool; market, shops, wholesale, agricultural market; laundry, chemical cleaning center; hotels in town and soum center, its restaurants; public catering establishment, restaurant, canteen; public bathhouse; sauna; hair and beauty salon; public toilets; auto maintenance and services; railway station, its service water

C. Industrial water use

a) *Food industry water use*

- pastry (bread, bakery, cookies, noodles, cake) ; processing of meat products; dairy products, processing of (packed milk, cream, curds, cheese, ice-cream); processing of fruits and vegetables; candy and sweets; alcohol, beer, lemonade, wine; spirit industry

b) *Light industry water use*

- washing and processing wool and cashmere; carpet; knitting; yarn; textile; felt material, felt-boots; peltry (processing of lamb, kid, squirrel, marmot, sable, fox, corsac fox, caracul skins); skin processing; leather products; processing of goatskin leather; chevrette processing; chrome processing; boots; wood and wooden product workshop; furniture and cardboard workshop; medicine for people and livestock; soap; cosmetics; waste paper processing; garbage and litter processing; cigarette; packaging; fodder; glass industries

c) *Heavy industry water use*

- maintenance and mechanic factory (maintenance and mechanic factory of Erdenet industry)
- iron industry (scrap metal processing industry of Darkhan and Ulaanbaatar cities)

d) *Construction and construction material production water use*

- construction field water use (concrete maintenance, plastering)
- concrete; iron concrete (concrete product), mass concrete (light concrete), buto concrete product; blocks, bricks (red bricks, silicate), veneer (pile, mosaic); sand, gravel, rock debris extraction and washing; processing of cement, chalk; granite stone; metal cast (armature etc) industries and workshops

e) Energy water use
- hydropower plant
- power plant (*cooling and heating, thermal water);* heating furnace
- underground thermal use

f) Mining extraction, enrichment and processing industry water use
- coal; gold; copper, molybdenum; spar; iron; zinc; wolfram; tin; rare metal; mixed metal; oil

D. Agricultural water consumption and water use

a) Livestock water consumption
- pastoral livestock; farming (milk and meat cows); pig and hennery farm; pets (rabbit and dog etc)

b) Irrigation water use
- agriculture (irrigation system, greenhouse); harvesting; water demand for family and household farming

E. Tourism and sanatorium water consumption and water use

a) Tourism water consumption
- hotels and tourist camps outside the cities; foreign and domestic visitors and tourists

b) Sanatorium water use
- camps; spa resort; campers and vacationers' water consumption

F. Green area water consumption

a) Green area water consumption
- irrigation for lawn and trees inside city; park; preparation of trees and seedlings

b) "Green Wall" program water consumption

G. Road and transport water use

a) auto-road construction and maintenance
b) car wash
c) railway constructions

The information and data on actual drinking water consumption and water use for 2008 and 2010 in Ulaanbaatar city and aimag centers are obtained from USUG in Ulaanbaatar and from PUSO's.

The information and data on people who have their own boreholes are rare and it is impossible to determine the amount of water they use.

When calculating 2008 and 2010 urban and rural population drinking, industrial (heating, thermal water), mining and agricultural water consumption and water use, it was based on industrial data of NSO; Ulaanbaatar city and aimags' PUSO and USUG data on actual water consumption and water use; temporary norm of water demand which was approved by 153rd order of 1995 of the Minister of Nature and Environment.

The data and information on 2008 and 2010 actual drinking and industrial water consumption and water use of soums' population are obtained from aimags and soums. But they are not actual and reliable data and information.

The 2008 and 2010 population and sectors' water consumption and water use were calculated by each soum, district, aimag and Ulaanbaatar city. On the basis of these the water consumption and water use was calculated by river basin.

If the basin border divides aimag and soum administrative units, rural (herders and farmers) population and livestock water consumption was calculated using the pasture percentage of the soum in the basin.

1.2.3. Future trend of water consumption and water use (water demand)

The future trend of water consumption and water use or the water demand is calculated for the years 2015 and 2021 using high, medium and low scenarios in accordance with the growth of water consumers and users and the future trend of the socio-economic development. The medium scenario indicates normal growth that can be in the future. The high and low scenarios indicate high and low limits of water demand growth. When calculating scenarios, it was based on plans and policies from the Government and relevant ministries.

In the calculation, it is considered that when the number of water consumers and water users increase, water supply level and water use norm will be changed in the future. The framework of the water demand calculation is presented in Figure 1.

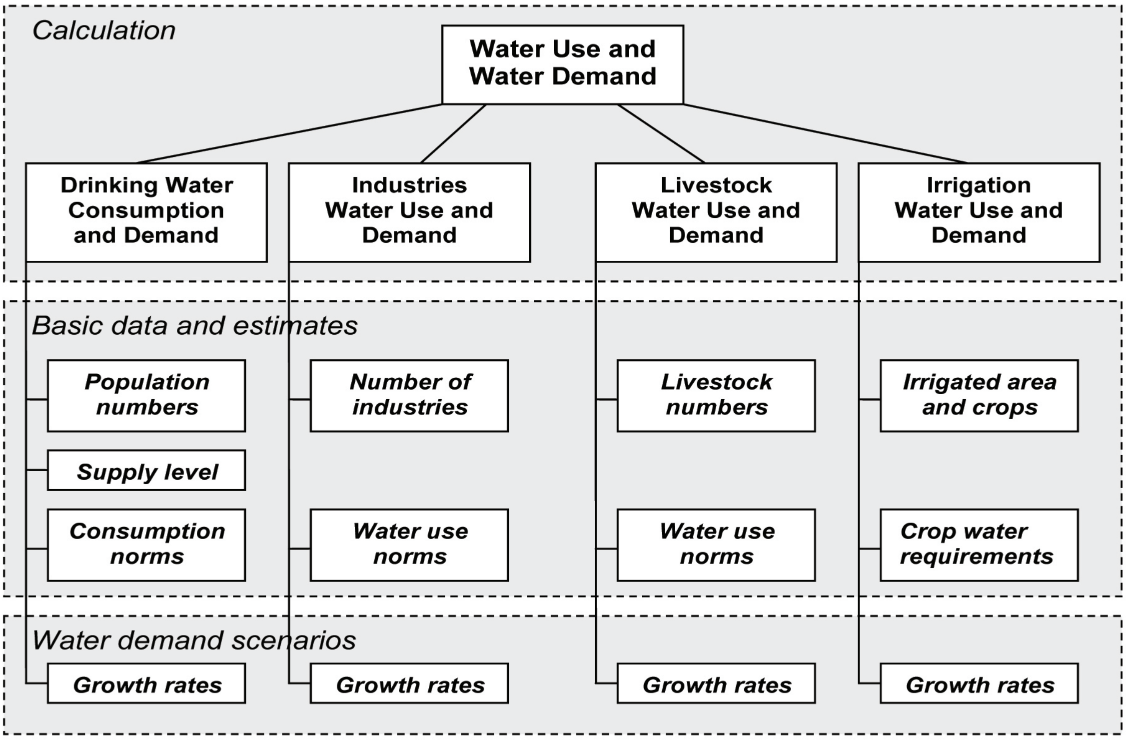

Figure 1. Computational framework of water consumption and use and water demand calculation

1.2.4. Hydro constructions

Data and information on hydro construction types and number, current and future trends are obtained from relevant organizations and they are used in the report.

In this report, water supply constructions of population, industries, mines, agriculture, tourism and green areas are mentioned in the water supply chapter of the sectors. So some brief information of the following is included. They are: hydro constructions including flood protection facility, dam (irrigation system head construction, water distributing facility), rain and snow water accumulation (reservoir and pond).

Hydropower plant facilities are mentioned in the industrial water supply part.

Sewerage and waste water treatment facility are reported separately.

2. Sector water supply

2.1. Urban and rural area population drinking water supply

The source and supply of population drinking water is different in rural and urban areas. It is mostly supplied from groundwater.

Large urban areas such as Ulaanbaatar city, aimag centers and large soum centers like Baganuur, Khutul, Bor-Undur, Kharkhorin and Zuunkharaa have centralized water supply networks. Urban ger districts, soum centers and rural areas have non-centralized water supplies.

Apartment buildings in Ulaanbaatar, Darkhan, Erdenet, Sukhbaatar, Choibalsan, Khutul and Bor-Under are connected to hot and cold water pipelines. The other aimag centers, villages and soum centers only have connection to cold water pipelines.

In the last years, kiosks in Ulaanbaatar city and aimag centers' ger districts were built and connected to the centralized networks. It is possible to connect houses to the centralized networks only in the big city centers. In soum centers, schools, hospitals and administrative offices are connected by cold water pipelines.

Urban and aimag centers' water supply sources are protected and fenced. Most of the kiosks, springs and ponds that are used for water supply in ger districts, soum centers and rural areas are not protected.

Figure 2. Fenced kiosk and spring

The terminology of "centralized[1]", "decentralized[2]" water supply is specified in the "Law on Utilization of Urban Settlement's Water Supply and Sewage". In order to supply the population with safe drinking water, the concepts "**improved**" and "**unimproved**" water supply are used widely by professional organizations according international standards as in the research work "Access to Water and Sanitation Services in Mongolia" which was conducted by UNDP in 2004 and 2008.

Water availability and water source data is obtained from NSO and PUSO. The percentage is uneven when comparing data and information of 2008 and 2010. The

1 "centralized water supply" means operation to supply consumers with clean water, using piping network and facilities designed for abstracting, treating, transmitting, and delivering water

2 "decentralized water supply" means operations to supply users with clean water by transporting water from well and water distributing center (kiosk)

number of kiosks that are connected to the centralized networks increased (Table 3).

The research work conducted by UNDP aimed to determine the difference in improved and unimproved water supply sources. The improved sources include kiosks and apartments that are connected to the centralized networks, protected water sources (protected boreholes, springs and ponds etc). The unimproved source includes portable water and unprotected water sources.

Not connected kiosks supplied by tanker trucks are considered as unimproved sources by UNDP. In this report the not connected kiosks are considered as improved sources as measures to protect and disinfect the tankers trucks are taken by the water supply companies. However it should be considered that this is not guaranteed everywhere.

Table 3. Access to water sources and coverage

Population and type of water source	Main cities		Other cities and soum centers			Rural area			
	2004	2008	2010	2004	2008	2010	2004	2008	2010
Population, thousands	1,200	1,268	1,373	650	710	735	700	667	640
From central connection, %	50.0	39.0	39.0	3.0	1.0	1.0	-	-	-
Connected only to cold water pipeline, %	4.0	-	-	13.0	6.0	6.0	-	-	-
Kiosks connected to centralized pipeline, %	7.0	20.0	22.0	31.0	10.0	15.0	-	-	-
From tanker truck water, %	37.0	24.0	23.0	26.0	40.0	37.0	-	-	-
River, spring, pond, and unprotected well, %	-	17.0	15.0	9.0	42.0	40.0	70.0	100.0	100.0
Only unprotected wells for households and community, %	2.0			18.0			30.0	-	-

Main cities: Ulaanbaatar, Darkhan, Erdenet, Baganuur, Khutul, Choibalsan, Bor-Undur
Source of data: UNDP, 2004; NSO, PUSO 2008, 2010; Population data based on soum population data obtained from NSO (total 2,747,500 in 2010)

The percentage improved sources is rising (Table 4). In 2010 an estimated 71.6% of the population was using improved sources. If excluding not connected kiosks then an estimated 50% of the population used improved sources.

Table 4. Water supply coverage drinking water

Type of water source		2008	2010
Central water system	Apartment population, %	20.7	21.7
	Population supply from kiosks, %	12.0	14.5
Water transportation	Population supply from kiosks or water vendors, %	23.0	22.8
Protected sources	Population supply from wells, springs, %	11.0	12.9
Unprotected sources	Population supply from wells, springs, %	20.8	20.7
Other sources	Population supply from rivers, lakes and ponds, %	12.5	7.5
Total, %		**100.0**	**100.0**
Total improved sources, %		**66.7**	**71.8**
Total unimproved sources, %		**33.3**	**28.2**

2.1.1. Urban drinking water supply

Urban drinking water supply and sewerage facility use issues are regulated by the "Law on Utilization of Urban Settlement's Water Supply and Sewage".

The following urban areas are included in urban drinking water supply: Ulaanbaatar (7 districts), all 21 aimag center cities and Nalaikh and Baganuur districts of Ulaanbaatar, Kharkhorin of Uvurkhangai, Zamiin-Uud of Dornogovi, Khutul and Zuunkharaa of Selenge, Bor-Under of Khentii.

Ulaanbaatar: There are 176 boreholes of 4 main sources (Upper, Central, Industrial, Meat Combinat). The population, industry, public services and organizations drinking water is supplied by 350.3 km pipelines. Some 300 kiosks in the ger districts are connected to the centralized networks. Ger district people are supplied also from 260 not-centralized kiosks. Ulaanbaatar city power plants' technological water demand is supplied from the Nisekh and Biokombinat water supply sources. Drinking water is abstracted and distributed by USUG (Water Supply and Sewerage Company) to many OSNAAG-organisations (Heat and Water Distribution) serving apartment residents, and to industrial and institutional customers in the city. USUG also provides water for piped and tanker distribution to the kiosks in the ger areas.

USUG distributes water to the ger district population from kiosks that are connected to the centralized networks; not-connected kiosks and water trucks. Private people and organizations drilled some 800 boreholes in their own areas on their own expense and use them for their drinking water consumption. USUG has equipment which has a capacity of extracting and distributing 255,000 m^3 groundwater per day. With the Japanese Government grant (JICA), Gachuurt water supply source is being built which has 25,000 m^3 usage resources.

Erdenet: The main source of Erdenet water supply is 63 km from the city in the Selenge river alluvial plain groundwater. The water is extracted and distributed to Erdenet city apartment population, Erdenet ore dressing industry, other industries and organizations through 4 pumping stations from 14 boreholes. The ger district population is supplied from not centralized kiosks and transported water.

Darkhan: The 3rd largest industrial city in the country has a centralized water supply. The ger district population is supplied from not centralized kiosks. The water supply facility and equipment of the city is in a bad condition and was renovated in 2010 by a Japanese grant.

The recent works included cleaning pipelines; installing administrative systems and monitoring equipment and renovating kiosks. The water source boreholes were maintained and renovated increasing the capacity to 70.000 m^3/day.

Other aimag centers: The apartments, organizations and industries of Choibalsan, Khovd, Murun and Arvaikheer have a centralized water supply and hot and cold water pipelines. The other aimag centers have only cold water pipelines. The aimag center ger districts have not-centralized kiosks and portable kiosks. The water is carried by hand from the protected sources.

Other villages: The apartments, organizations and industries of Baganuur, Khutul and Bor-Undur cities have a connection to hot and cold water. The apartments and organizations of Kharkhorin, Zamiin-Uud and Zuunkharaa have connection to the centralized networks of cold water. The typical lay-out of an urban water supply for large cities is presented in Figure 3.

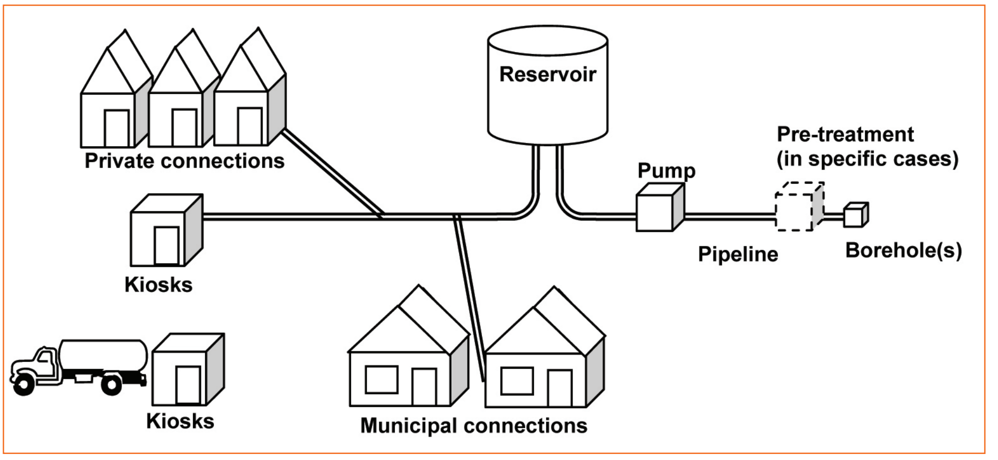

Figure 3. Typical lay-out of an urban water supply for large cities

Not centralized water supply kiosks of urban and village ger districts have a borehole with an electric pump and there is small house with a water tank. The water tank is located inside the kiosk which provides also the working environment for the kiosk workers. The kiosk and water tank water is distributed without treatment.

The typical quantities of the water supply facilities of the large size urban centers are presented in Table 5.

Table 5. Typical quantities of urban water supplies for large cities

Large size urban centers						
Population	City	Supply capacity *(m^3/day)*	Number of boreholes	Length pipeline *(km)*	Reservoir capacity *(m^3)*	Number of kiosks
> 1,000,000	Ulaanbaatar	255,000	176	350	46,500	470
85,000	Erdenet	70,000	14	180	60,000	42
77,500	Darkhan	70,000	18	215	16,000	40
30,000 - 50,000	Choibalsan	1,250	10	39	2,000	50
10,000 - 30,000	Aimag centers	250-750	6	8	600	30

As for large aimag centers (Darkhan, Choibalsan, Murun), houses, apartments, organizations and industries are supplied from the centralized networks and not centralized kiosks.

In the last few years, measures were taken to expand and improve urban water supply. Groundwater resources research was conducted. The water supply is increased by certifying resources, constructing new water supply sources, expanding water transmitting pipelines and water storage facilities, connecting kiosks to the centralized pipelines and constructing new kiosks. For example: 60 billion tugrugs was invested to this work from the state budget for the last 5 years. For the last 10 years, 16 projects were implemented by foreign loans and aid. 16 projects had 140 million dollars investment.

As a result, some 410 km fresh and waste water, heating pipelines; reservoir; waste water treatment facility; boreholes were conducted by the state budget investment between 2008 and 2010. Within the framework of the World Bank and Asian Development Bank projects, some 250 km fresh and waste water, heating pipelines and 7 waste water treatment facilities were constructed. Some 30 kiosks are connected to the centralized networks and 30 new kiosks were constructed. Water softening equipment was installed at kiosks of 130 soum centers (O.Tsedendamba, 2011). In the framework of UNDP's "Improving Water Supply and Sanitation Availability" project, water supply and waste water treatment facilities are renovated in some soums of Khovd and Gobi-Altai aimags.

2.1.2. Rural drinking water supply

According to the "Calculating Main Indicators of Population Statistics" method of NSO, rural drinking water supply includes soum center and rural population (herders, farmers) water supplies.

Soum center

Groundwater is mostly used as soum centers' water supply source. Soum center schools, hospitals and administrations have connection to cold water pipelines. The ger districts are supplied from boreholes, hand-wells or open water (rivers, ponds, lakes, protected and unprotected ponds and springs). Soum centers have 3-6 boreholes. The ger district people of some soum centers are supplied from open water by water trucks, horses, carts and oxcart.

Figure 4. Soum center water supply boreholes

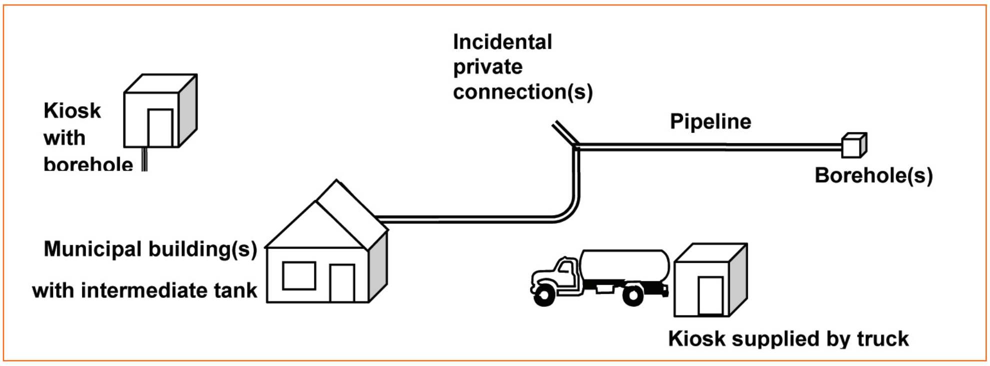

Figure 5. Typical lay-out of a water supply for soum centers

Additional treatment of water is required in special cases to reduce hardness and salinity (TDS). Treatment is not done to remove heavy metals (arsenic, fluorite, mercury) or traces of pesticides.

Figure 6. Water softening equipment installed at soum center kiosk

Maintenance of small scale treatment systems has proven difficult due to unreliable power supply, lack of good service, bad logistical delivery of water filter, chemicals and spare parts and difficulty to organize operational and maintenance activities.

Water supply source compared to soum center population number and average facility indicators for water supply are presented in the table below.

Table 6. Average indicators of soum center water supply

Soum centers						
Population	Supply capacity *(m^3/day)*	Number of boreholes	Length of pipeline *(km)*	Reservoir capacity *(m^3)*	Number of kiosks	Number of connections
5,000 – 10,000	125-250	3-5	4	300	8	50
2,000 – 5,000	50-125	3-4	2	150	4	20
1,000 – 2,000	25-50	2-3	1	60	2	10
< 1,000	< 25	2	1	-	1	..

Note: Capacity based on 25 l/day/person

Rural areas

The steppe forest and steppe zone rural population (herders, farmers) usually use engineering designed boreholes (drilled, short tube, concrete ring) and pond, springs and snow water for their drinking water in winter and spring. In the warm season, open river water is directly used for drinking water. Surface water is rare in the Gobi areas and groundwater is used for drinking water all year around (Figure 7).

The relevant organizations do not have latest detailed research materials, data and information on rural population water consumption.

Figure 7. Water sources used for rural water supply

The drilled borehole used for rural water supply extracts 10,000 l water per day on average. Some 50 people, 1200 small cattle and 200 large cattle are supplied. The water is used directly without treatment.

Figure 8. Damaged pit well used for drinking water

The boreholes are not constructed just for the drinking water of the rural population. Since 1988 to improve pasture use and livestock water supply, money was used from the state budget for the maintenance of engineering designed boreholes and the construction of new boreholes. MFALI counted in 2009 a total of 42.3 thousand wells of which 24% boreholes and 76% dug wells and reservoirs with a total volume of 92.5 thousand m3. Of the wells 7% are not used and 26.8 thousand or 63.4% are located in the pasture area.

The “Mongolian Livestock” National program aims to construct new boreholes with the participation of herder groups and communities to share costs of constructing new wells in order to increase the sense of ownership, transfer the responsibility for use, protection and maintenance and aims to create water reservoirs to catch rain or snow water. The program aims to construct new wells: 2400 in 2012, 3600 in 2015 and 2686 in 2021; while the Water National Program aims to construct 800-1000 wells per year. While it is for the improvement of pasture use and livestock watering, it will be good for the improvement of rural population water supply as well.

2.1.3. Recommendations and conclusions on urban and rural population drinking water supply

- Most of the urban water supply source and engineering pipeline facilities are constructed between 1960 and 1990. So, there are breakdowns and it is difficult to provide a reliable operation. Large investments are needed for the renovation over a long period of time.
- Some 36 percent of the Ulaanbaatar city and aimag centers' population are supplied from not centralized or unimproved water supply source. Much work should be done in order to have the urban water supply system reach the standard requirements.
- It is required to increase the water abstraction capacity to cover the population and industrial water demand of Ulaanbaatar and other urban areas. Many private boreholes were drilled in and around Ulaanbaatar (about 800 boreholes) and this number will increase further. The increase of the groundwater abstraction will reduce the available groundwater resources.
- Economic entities that run industrial activities drill boreholes in their private area/land and use much water without any permission and registration.
- The protection of the urban water sources is facing difficulties due to urban construction expansion and unorganized solid waste disposal. There is a risk of pollution of the sources due to mass construction of apartments and industries at the north of the central source which is the main Ulaanbaatar city groundwater source. Some boreholes at the industrial and meat are polluted and they are closed. USUG stopped the supply from some boreholes which have polluted water and these boreholes' water is used for industrial water demand.
- Most of the water supply sources are close to urban areas. There is a high risk of water pollution. So it is required to determine protection and hygienic zone that protects water sources. It should be obeyed.
- The Government and Ulaanbaatar city administration pay much attention to improve and expand the Ulaanbaatar city water supply sources. It is planned to construct a reservoir to store surface water in the upstream part of the Tuul river catchment. The "Tuul River Water Complex" will be a development that has much importance. The benefits from this large Complex should be studied thoroughly. Benefits will be for example: establish reliable sources of Ulaanbaatar city water supply, use river water energy, protect from flood, protect river ecology, develop water sport and tourism near the city and breed water animals.
- It is possible to reduce water losses by installing water meters in large cities' apartments (water running due to open water faucet, water loss due to fresh water pipe breakage) and taking full fee. As for Ulaanbaatar city, according to USUG data, water loss was reduced from 30 percent in previous years to 17 percent in 2010. The measures taken by USUG include replacing pipelines and installing water meters.
- It is important to increase the number of ger district kiosks and bring the water supply availability closer to water consumers.
- Last years houses and organizations are connected to the centralized networks. As for Ulaanbaatar city, some 70 percent of the population will be connected to the centralized networks by implementing programs "100000 Household Apartments" and "Apartments for Ger Districts".

- Much investment is required in aimag centers to improve water availability by increasing the number of kiosks, by drilling new boreholes and by connecting ger districts' kiosks to the centralized networks.
- SCADA (Supervisory Control and Data Acquisition) computer program was installed to monitor water losses in the Erdenet city water supply network. As a result, water loss was decreased by 10 percent.
- The following issues should be included in the water management plan to improve water supply. They include: replace and improve water distributing pipelines, decrease water loss and increase water supply efficiency.
- Last years, the Government and local area administration set the goals to construct facilities to increase aimag centers' water supply sources; expand water tanks and water distributing pipelines and increase number of kiosks. The continuation of these measures needs to be included in the water management plan.
- Measures to improve soum center water supply (connection to pipelines, maintenance of water supply boreholes, increase of kiosks by drilling new boreholes, construction of waste water treatment facilities) are being taken and investments are limited.
- One main objective of the water management plan is to provide the population with safe drinking water. As of 2008, population in some 200 soum centers used unsafe and unreliable water for their drinking water[3].
- It is important to disinfect drinking water and treat groundwater with much hardness and mineralization. Last years, attention is paid to decrease mineralization and hardness (calcium, sodium) and water softening equipment was installed at soum center boreholes. But the equipment cannot be used. It is required to solve issues comprehensively including water quality monitoring, water softening and purification and water source protection.
- The quality of groundwater used for drinking water is variable in one soum territory. In general, low recharge groundwater sources have more mineralization than always recharged groundwater sources.
- The chemical industry is not much developed in our country, so there are very few pollutants that affect drinking water quality. The drinking water is polluted due to bad treatment, organic pollutants, biogene, gold mining and heavy metal from industries. If measures, to purify and prevent these elements from distributing in the environment, are not taken, rivers and water sources will be polluted. For example: Khongor soum center drinking water source of Darkhan-Uul aimag was polluted due to wrong doings of illegal gold miners in 2007. It had negative impact on population health.
- In rural areas, boreholes' and other types of wells water is used for drinking water. Mostly, they are not protected and fenced. Due to it, borehole and other types of wells water is polluted easily from dung and domestic waste. It is required to prevent water sources from pollution and fence them.
- Rural population and livestock water supply needs to be considered in comparison with urban population drinking water supply.
- It is required to have good plan coherence and to have investment efficiency increased in order to improve urban and rural population water supply.

3 Source: Presentation "MOH water and sanitation Eng.ppt" presented at the world water week conference in 2008. B. Batsereedene, Minister for Health. Based on PHI, 1992-2005

2.2. Agricultural water supply

Agricultural water supply includes water supply of pastoral and intensive livestock (farming) and irrigation (greenhouse). Its facilities are mentioned in this part briefly.

2.2.1. Livestock

The improvement of pastoral water supply is important to solve the issues to reuse Mongolian remote pastures and protect from desertification. The pasture without water is not pasture, it is just field with grass. So pasture areas should have enough water resources.

The following will be used for pastoral livestock water supply. They include: engineering designed boreholes (drilled boreholes, concrete ring and short tube), reservoir, ponds and normal designed dug-wells depending on seasonal features. Rivers, ponds, springs and lakes are used as source (Figure 7).

Figure 9. Normal dug-well

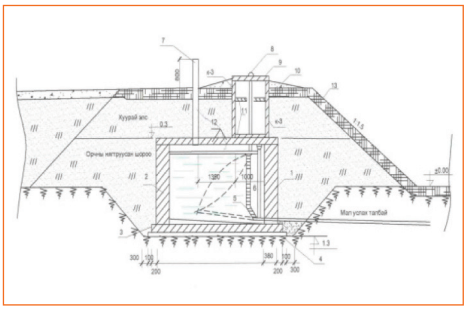

Figure 10. Reservoir lay-out which was constructed in winter and spring camps.

Engineering designed boreholes are usually used for livestock watering in winter and spring camps in the seasons of winter and spring.

From the early 1960's, drilled boreholes started to be constructed by state investment and there were in total 42.9 thousand boreholes in pasture by 1990. Some 17 thousand boreholes were normal hand-wells. As a result, 65.4 percent of total pasture was supplied by water. By 2007, 17600 engineering designed boreholes are out of service. The water supply level was reduced to 32.8 percent or 39754 ha pasture is without water and out of use. It destroyed 30 years' hard work. Until 1990, some 2255 ha pasture was irrigated by water point on average (L.Janchivdorj, 2007 report).

Reservoirs with an 8-16 m^3 capacity (there were 1024 reservoirs between 1976 and 1990) were established in pastures without water or with difficult geological and hydro-geological conditions. After the 1990 market economy transition, engineering designed boreholes were put under state property. They were left without owners and they were damaged. Many boreholes and reservoirs were out of service, because there was no maintenance. According to MFALI data, as of 2009, some 1000 reservoirs (92.5 million m^3) and 6 ponds are used for livestock water supply.


Figure 11. Damaged drilled borehole and concrete ring borehole in pasture

Some 6663 engineering designed pit well, short tube wells and boreholes were out of order in 2008.

The Government of Mongolia paid attention to the maintenance and new construction of engineering designed boreholes in pasture since 1998. Many boreholes were maintained and newly constructed by state budget and international organizations' loans.

For the last 13 years, 27.1 billion tugrugs was spent from the state budget and 4891 engineering designed boreholes were maintained and newly constructed. The pasture water supply was improved. Some 2.4 million tugrugs is spent on maintaining one borehole on average and 10.2 million tugrugs is spent on the construction of new borehole on average. In 2008, 672 new wells were constructed and 215 wells were rehabilitated by international organization's aid.

The borehole numbers, used for population and livestock drinking water between 1990 and 2009, are presented in the table below.

Table 7. Borehole number used for rural population and livestock drinking water.

Well types	1990	2000	2003	2006	2007	2008	2009
A. Total number of engineering wells	27,556	8,183	19,189	10,000	16,278	18,560	10,200
• Borehole (40-200m)	7,486	-	5,542	-	5,397		
• Short tube well, concrete ring combined with borehole (10-30m)	7,624	-	6,022	-	4,482		
• Pit well, concrete ring only (10-30m)	12,446	-	7,605	-	6,399		
B. Simple dug well (3-5m)	14,024	22,714	20,654	28,600	23,008	24,522	32,100
Total	**41,580**	**30,897**	**39,843**	**38,700**	**39,286**	**43,082**	**42,300**

Source: MFALI, 2010

The improvement of livestock water supplies goes together with the improvement of water supply for the rural population. The Parliament approved the MDG based National Comprehensive Development Policy in 2010. In the MDG based National Comprehensive Development Policy "Water" and "Mongolian Livestock" national programs, it is planned to improve livestock water supply by constructing 800-3600 boreholes annually for livestock water use.

The Government and MFALI set goals to support herders in order to improve livestock breed, increase production of meat, milk, wool and cashmere and improve herders' living. The Government follows a policy to develop intensive livestock or farming settlement and half-settlement farming near settlement areas and regional main centers besides improving livestock breed. The example is that since 2010, American "Millennium Challenge Account" gives financial support for farms around cities to drill wells.

2.2.2. Irrigation

To increase the agricultural crop production it is required to have irrigation.

In 1990, 482 irrigation systems were constructed in Mongolia, with a capacity to irrigate a total area of 91.6 thousand ha. Of these 156 engineering designed irrigation systems were constructed by state budget with a capacity to irrigate 49.5 thousand ha. and 326 simple designed irrigation systems were constructed by local area budget with a capacity to irrigate 42.0 thousand ha. (Table 8). Some 90 percent of the irrigation area was used until 1990. The irrigation systems that were constructed by state and local area budget are damaged and spoiled since 1990 due to no ownership. The irrigation area is dramatically decreased. The state owned irrigation systems were privatized since 1996. Many of them are left without owners due to a lack of financial ability.

Figure 12. Irrigation sprinkler

Figure 13. Irrigation from the borehole

Table 8. Status of engineering and simple designed irrigation systems that were built until 1990.

№	Aimag	Irrigation systems built before 1990		Engineering designed		Simple designed		2008		2010	
		Number	Capacity ha	Number	Capacity ha	Number	Capacity ha	Number of irrigation systems	Area of irrigation systems, ha	Number of irrigation systems	Area of irrigation systems, ha
1	Arkhangai	6	2 408	3	921	3	1 487	2	363.5	2	493.4
2	Bayan-Ulgii	39	5 705	10	2 230	29	3 475	11	3 362.3	11	4 400.7
3	Bayankhongor	34	2 530	13	1 181	21	1 349	14	437.1	14	574.0
4	Bulgan	23	2 064	4	264	19	1 800	4	1 300.3	5	1 898.4
5	Gobi-Altai	49	6 125	17	5 547	32	578	17	1 731.1	17	3 513.9
6	Dornogovi	7	340	3	319	4	21	3	50.0	4	100.5
7	Dornod	19	1 956	4	1 771	15	185	4	556.1	4	1 090.8
8	Dundgovi	25	179	2	104	23	75	3	50.1	3	100.1
9	Zavkhan	37	9 952	14	1 651	23	8 301	14	423.3	14	1 079.7
10	Uvurkhangai	25	9 039	5	8 600	20	439	4	522.2	5	764.8
11	Southgobi	34	500.5	15	468	19	32.5	7	205.4	10	173.1
12	Sukhbaatar	5	119	3	90	2	29	3	50.3	3	98.4
13	Selenge	25	9 887	9	5 617	16	4 270	55	6 620.8	55	9 283.2
14	Tuv	36	3 992	12	3 614	24	378	32	1 930.0	32	1 273.5

№	Aimag	Irrigation systems built before 1990						2008		2010	
				Engineering designed		Simple designed					
		Number	Capacity ha	Number	Capacity ha	Number	Capacity ha	Number of irrigation systems	Area of irrigation systems, ha	Number of irrigation systems	Area of irrigation systems, ha
15	Uvs	31	9 415	11	7 063	20	2 352	12	4 999.9	12	4 174.7
16	Khovd	32	17 485	12	5 679	20	11 806	13	2 774.1	13	2 654.5
17	Khuvsgul	22	5 369	3	307	19	5 062	6	461.7	6	577.6
18	Khentii	20	1 832	3	1 394	17	438	5	526.0	5	609.6
19	Ulaanbaatar	7	986	7	986	0	0	15	1 390.8	15	1 389.0
20	Darkhan	5	1 185	5	1 185	0	0	5	1 430.0	6	2 128.4
21	Orkhon	1	547	1	547	0	0	3	819.0	3	1 129.7
22	Govisumber							1	12.6	1	59.1
	Total	**482**	**91 615**	**156**	**49 538**	**326**	**42 077**	**233**	**30 016**	**240**	**37 567**

Source: MFALI, 2010.

The objective is that 25-30 percent of grains and crops will be harvested from irrigation areas by 2015 according to the "State Policy on Food and Agriculture". The "Water National Program" plans to build reservoirs with a volume less than 25 million m^3 by 2021 and more than 10 thousand ha crop area will be irrigated. As for "3rd Session of Wilderness" program, 22 thousand ha area irrigation system will be in use by 2010. Reservoirs with a volume of 15 million m^3 water will be constructed. The biggest objective is to harvest 25-30 percent of wheat and crops from irrigation. In order to achieve above mentioned objectives and supply domestic needs with crop products, the Government started organizing measures to rehabilitate old irrigation system and construct new ones by giving financial support to farmers from state budget and foreign aid since 2003. As a result, irrigation area is increasing each year.

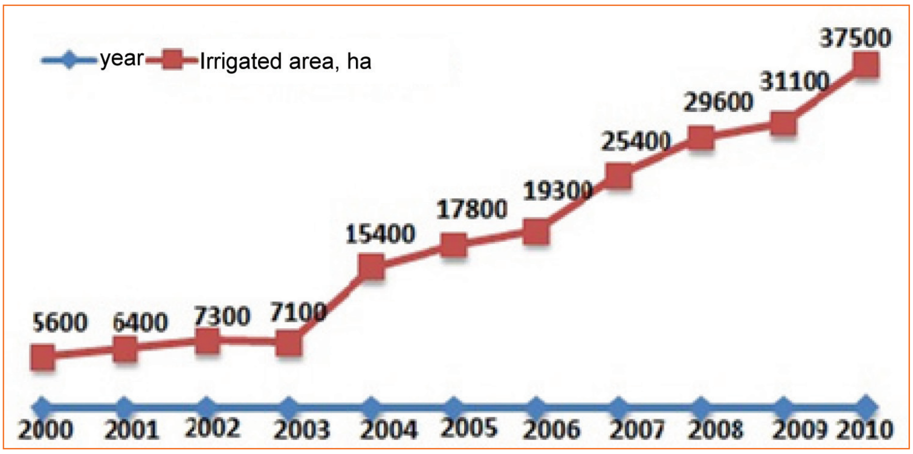

Figure 14. The growth of the irrigated area

Between 2003 and 2010, some 101 irrigation systems were rehabilitated and the possibility to irrigate 19.2 thousand ha area was created by state and private investments – some 16.3 billion tugrugs. Some 195 irrigation systems were newly created by 45.3 billion tugrugs investments. The possibility to irrigate 17.0 thousand ha area was created.

Mostly potatoes, vegetables, wheat, crops and fruits are grown by irrigation systems. Surface water is used as water source. But, lately groundwater is being used also as water source. Exact data is unavailable as there is no organization that conducts monitoring on which irrigation system is supplied from which water source and what is the actual water use.

Table 9. Irrigation area size and crop types of 2010

	State total	Grain	Potato	Vegetable	Fruits	Fodder
Irrigation area *thous ha*	37.5	9.5	9.9	7.2	589.3	3.8
Percentage	11.8	5.2	71.5	100.0		30.2
Crop harvested *thous ton*		19.1	122.4	80.5	258.2	10.1
Crop percentage		5.2	72.4	89.1		26.0

As of 2010, crop was planted in 37.5 thousand ha areas. Wheat was planted in 9.5 thousand ha, potatoes in 9.9 thousand ha, vegetables in 7.2 thousand ha, fodder in 3.8 thousand ha and fruits in 589.3 ha. In other words, 11.8 percent of total crop planted area is irrigated; 71.5 percent of total potato field was irrigated and vegetables were 100 percent irrigated.

When using surface water and groundwater for irrigation, surface and water-sprinkler methods and technologies are used widely.

Surface irrigation method: There are two methods: when using surface water, river water is taken by channels with the aid of head works; when using constructed dams and artificial lakes water is taken by water abstraction facility. There are three main methods in surface irrigation. They are furrow, border-strip and flood irrigation.

Figure 15. Furrow

Figure 16. Border-strip

As for border-strip, irrigating potatoes and vegetables in open field is beneficial. The water infiltrates well into soil and it prevents from soil wash out, soil erosion and washing of nutrients.

As for flood irrigation, this method is usually used for hay making.

Sprinkler irrigation method: there are two sprinkler methods in irrigation. They are sprinkler and gun mounted. Data on sprinkler equipment is included in the hydro construction chapter.

Drip irrigation method is also used. Also there are mist and infiltration irrigation methods. But they are not widespread in our country. Drip irrigation system is being introduced in greenhouses and small vegetable fields. This system has little water loss.

2..2.3. Recommendations on agricultural water supply

- The Government started investment for livestock water supply improvement from 1998 and irrigation support since 2003. The amount of investment is increasing year by year. But, issues on borehole use, protection and ownership have not been solved.
- According to a 2009 inventory of MFALI, 63.4 percent of total boreholes are located in the pasture area and 7 percent of them are out of order.
- In order to improve rural water supply, much money is used for construction and maintenance of boreholes from state budget, foreign aid and international financial organizations' loans. Mostly, new boreholes are drilled and constructed nearby old boreholes. This does not have benefits for the use of remote pasture.
- The number of engineering designed boreholes in 2010 is decreased compared to that of 1990. It is because engineering designed boreholes (concrete ring and short tube) are old, damaged, spoiled and out of order.
- It is important to determine engineering designed wells and boreholes' location and demand in comparison with each soum pasture capacity, livestock density, surface water resources and multi-year average of precipitation. Borehole drilling activity should be planned and implemented on the basis of that.
- The natural water sources are used for rural population and livestock water supply. They include: rivers, ponds, springs and lakes. Also boreholes, reservoirs and ponds are used widely. When engineering designed boreholes, reservoirs and ponds are decreased, herders do not move and live for a long time next to remaining boreholes. In warm seasons, they concentrate next to rivers, ponds, lakes and springs. Due to it, pasture is degraded nearby water source and water resources are decreased.
- In 2005, the rule was made by Ministers of Food and Agriculture; Nature and Environment and Finance. It is "Common Rule to Rehabilitate, Construct, Finance, Own and Use Engineering Designed Boreholes and Water Point". But, this rule is not fully implemented and maintenance of most boreholes in pasture is bad. Also, rural water supply boreholes' ownership and usage are not that good.
- In places where there is not surface water resource, simple hand wells are used as water source. It is important to organize borehole maintenance activity correctly when drilling new boreholes for improving rural population and livestock water supply.
- World countries use much water for crop irrigation. Surface irrigation methods are inefficient and increase water loss. It is required to avoid this method.
- It is required to introduce irrigation methods that have low irrigation water loss in Mongolia. Mongolia is arid and irrigation system efficiency need to be increased.
- "BAUER" sprinkler machine is suitable for planting crops and grains with irrigation in 50-200 ha area. As for area larger than 200 ha, American and Canadian made "Fregat" sprinkler is suitable.
- As for small entity and household crops with area of less than 10 ha, Chinese made sprinkler which has capacity to irrigate 1-30 ha is suitable. This sprinkler has diesel compression and its movement is conducted manually in the field.

- Drip and infiltration irrigation in the farming of potatoes, vegetables and fruits uses water economically. It prevents soil from salt and nutrient wash out. It should be supported and spread.
- Covering vegetables and potatoes in open fields with black layer has benefits to decrease water evaporation, to accumulate heat in the soil and decrease the growth of weeds. It was proved by the industrial test within the framework of "Desertification Decentralization" project in Khovd aimag. It is being implemented by Swiss Development Agency.
- According to MFALI plan to National Innovation Committee, irrigation area will reach 69.500 ha in 2015 and 80.000 ha in 2021. In order to achieve these objectives, it is required to construct facilities to increase water sources by repairing old irrigation systems, constructing dams and reservoirs and using groundwater directly through sprinklers.

2.3. Industrial water supply

The Mongolian industry may be divided into the following main groups:

- Manufacturing industries:
  - slaughterhouses, meat processing etc;
  - tanneries and leather industries;
  - food and beverage (dairy, beer, soft drinks industry);
  - textiles (wool, cashmere etc);
- Heavy industries;
- Construction industries;
- Energy and thermal power;
- Mining industries (coal, copper, gold, metals, etc.).

The main industrial areas with manufacturing, heavy industries and construction industries are at Ulaanbaatar, Darkhan and Erdenet. Mining takes place typically in remote areas of the country. Power stations are located in the main industrial areas.

2.3.1. Manufacturing industries

The manufacturing industries produce mostly food products and beverages, textiles, clothes and other products processed from animal products. The largest concentration of industries is at Ulaanbaatar. Darkhan and Erdenet have a smaller number of industries. Outside these cities individual industries are located at aimag centers.

The manufacturing industry is being modernized in recent years but old processing techniques still exist. The industries either use own water supplies or use water from the central water supply system. To reduce service fee costs of the centralized water supply system, industries have drilled their own private wells for production. A good permit and monitoring system controlling industrial water use is lacking.


Figure 17. Textile and knitting industry

Some manufacturing industries have their own waste water treatment facilities. Most manufacturing industries usually do not have individual waste water treatment facilities. The wool and cashmere washing industries, tanneries are concentrated in Khan-Uul district of Ulaanbaatar city. They produce waste water with much chemical and heavy metal pollution. The wastewater effluent is released to the sewerage system, affecting the pipeline system and the central treatment plant facilities. This practice is affecting strongly the performance of the Ulaanbaatar central waste water plant, which treats industrial and domestic waste water. The industrial waste water is required to be pre-treated separately.

2.3.2. Heavy industries

The heavy industries are located in Darkhan and Erdenet cities. Darkhan's metallurgical factory and Erdenet's copper industry are supplied from centralized water supply networks.

Figure 18. Darkhan metallurgical factory

Figure 19. Erdenet copper industry

The heavy industries in Ulaanbaatar comprise metallurgical and repair enterprises and about 50 machine, agricultural machine tool and equipment repair industries are included in heavy industries. Most of them are connected to the centralized networks.

With the opening of new mines the government is planning to process more of the minerals inside Mongolia. New concentrator and other processing industries are planned near these mines. The Government and Parliament have decided to construct new industrial complex in Sainshand, Dornogovi.

2.3.3. Energy and thermal power

The Mongolian energy system is divided into four energy regions including Western, Altai-Uliastai, Central and Northern region. There are 7 thermal power plants which produce energy together with the Durgun and Taishir hydropower plants, diesel stations in Altai and Uliastai and small capacity energy industries. The electricity is distributed to the consumers through 220/110 KW sub-stations and 35/10/6/0.4 KW distributing networks.

Source: http://www.energy.mn

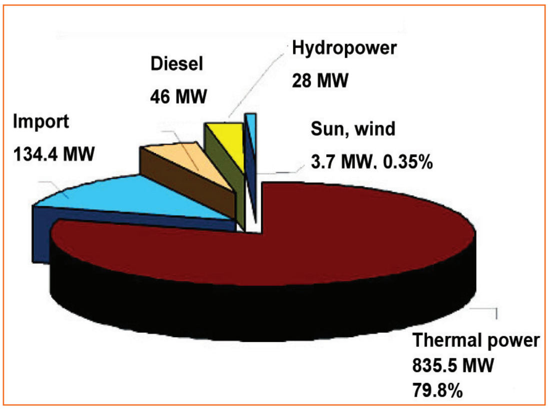

Figure 20. Energy resource use as of 2009

Figure 21. Ulaanbaatar thermal power plant 3

In 2009: 3989.7 million kilowatt hour electricity was produced by thermal power plants in the Central, Western and Eastern regions; 11.05 million kilowatt hour electricity was produced by hydropower plants; some 180.8 million kilowatt hour electricity was imported; 21.2 million kilowatt hour electricity was exported and some 2746.9 million kilowatt hour electricity and 6399.7 thousand Gkal heat were distributed to consumers (Figure 20).

Thermal power plants: The thermal power plants are concentrated in Ulaanbaatar and Darkhan. 228 soums out of 330 are supplied by electricity. As for the remaining soums, they are supplied by low capacity electricity stations and diesel engines. The Government is planning to connect all soums to the electricity network.

Integrated thermal power plants supply their water from their own boreholes and special purpose water sources. The thermal power plants use water for cooling and heating. The hot water from thermal power plants is used for heating of urban apartments in the cold season. It is used also for hot drinking water.

Hydropower plants: hydropower plants consist of a dam on a river which accumulates water and produces energy by turbine.

The world countries are required to use renewable energy as much as possible due to climate change, air pollution, greenhouse gas emission, raw material scarcity of energy and price increase which caused by environmental negative impacts. There is a trend to produce environmentally friendly energy from solar, wind, water, biomass or geothermal. Mongolia established the legal environment to use renewable energy by approving the “Renewable Energy National Program” in 2005 and the “Law on Renewable Energy” in 2007.

Figure 22. Taishir hydropower dam

Figure 23. Kharkhorin hydropower plant established on main irrigation system channel.

Originally hydropower plants constructed in Mongolia were low and average head stations. The water is transmitted by channel from a river and the head is established by the difference in water level. The first hydropower plant was established on the main channel of the Kharkhorin irrigation system in 1960 by Chinese experts. Its capacity is 528 kilowatt. The hydropower plant operated for 40 years until Kharkhorin was connected to the high capacity network.

Between 1980 and 2007, 10 small hydropower plants and 1 low capacity hydropower plant with a total capacity of 5208 kilowatt were constructed. They include: 2000 kilowatt on Bogd River, Zavkhan aimag; 375 kilowatt on Ider River, Tosontsengel; 400 kilowatt on Guulin, Gobi-Altai aimag; 150 kilowatt in Mankhan and Munkhkhairhan soums, Khovd aimag; 930 kilowatt on Uyench River, Khovd aimag and 200 kilowatt in Erdenebulgan, Khuvsgul. They only operate in warm season due to our country's climate conditions.

Durgun hydropower plant, 12 megawatt, and Ulaanboom hydropower plant of Taishir soum, 11 megawatt, were put in use in 2008, and have dams with large reservoirs. They are capable of operating all year around.

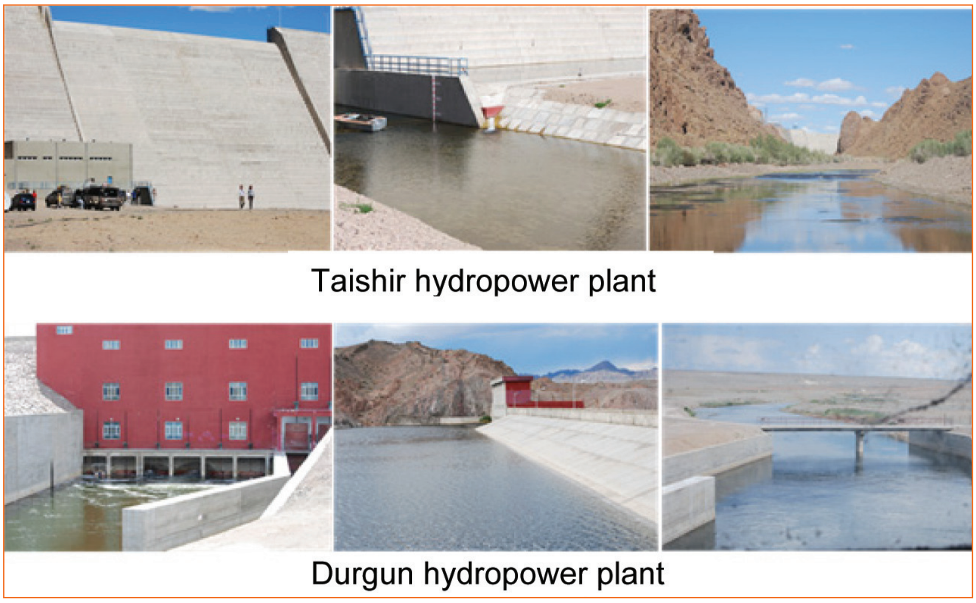

Figure 24. Taishir and Durgun hydropower plants

Ulaanboom hydropower plant of Taishir soum creates a 50 m head from a reservoir with a 60 m concrete dam.

As of 2008, 3.4 percent of our country's energy demand is supplied from hydropower plants. As of 2010, low and average head hydropower plants were constructed in 13 areas in our country. Some of them are not operating (Table 10).

Using river water energy in Altai, Khangai, Khentii and Khuvsgul mountainous regions has positive impacts on the economy and ecology. In winter, high mountain rivers freeze and it is important to collect water in summer time for hydropower plants' winter operation. Also possibility to operate all year around should be provided.

Table 10. Hydropower plants constructed in Mongolia

Name	Aimag	Capacity (MW)	River name	Estimated head *(m)*	Average runoff river *(m3/s)*	Annual energy production *(mill kWh)*	Water use *(mill. m³)*
Working stations							
Taishir	Gobi-Altai	11.0	Zavkhan	43.5	13.4	37	n.a.
Durgun	Khovd	12.0	Chono-Kharaikh	13.5	33.6	38.7	n.a.
Bogdiin gol	Zavkhan	2.0	Bogdiin gol	35	6.6	6	35.2
Guulin	Gobi-Altai	0.4	Zavkhan	40	3.2	0.9	6.2
Erdenebulgan	Khovsgol	0.2	Eg	4.5	40	4.4	26.9
Tosontsengel	Zavkhan	0.38	Ider	3	19.9	22	77.7
Uyench	Khovd	0.93	Uyench			1.5	n.a.
Not working stations							
Kharkhorin	Ovorkhangai	0.5	Orkhon	11	6	1.1	n.a.
Jigj	Uvs	0.2	Jigj	17	1.4	0.4	7.2
Mankhan	Khovd	0.15	North Tsenkher	11	1.6	0.4	8.2
Munkhkhairkhan	Khovd	0.15	Tsenkher	10	1.6	0.4	8.8
Total		**27.9**					

Data source: MME, WA

Professional organizations studied that it is possible to construct hydropower plants on 12 sites with 100-650 m head on Khovd river and tributary rivers; 11 sites with 160-800 m head on Bulgan river and Dund Tsenkher river; 8 sites with 100-296 m head in western part of Khangai mountains and 12 sites with 100-320 m head on Delgermurun and Shishkhid rivers.

Before the construction of a hydropower plant the water resource availability is calculated as part of the technical and economic analysis. The environmental negative impact issues are usually more important than water supply issues.

It is required to expand the energy system when Mongolian energy demand increases. An 18 megawatt capacity thermal power plant was put in use at Ukhaa Khudag in 2011. New thermal power plants are planned to be constructed in Ulaanbaatar and Murun cities by 2015. Research indicated 81 potential hydropower dam sites. Hydropower plants will be constructed in Chargait and Erdeneburen. Hydropower plants are planned to be constructed on Selenge, Eg and Orkhon rivers after 2015.

2.3.4. Mining industries

The mining industry is a leading economic sector as Mongolia supports export-oriented industries.

The mining industry includes metal and non metal and coal mining. As of 2009, 230 entities are operating in the field of natural resource use. They include: 3 copper-molybdenum mines, 103 gold mines, 38 coal mines, 1 zinc mine, 3 mixed metal mines, 5 wolfram mines, 2 tin mines, 9 iron mines, 24 spar mines and 42 construction material mines.

The mining industry percentage in our country's economy is increasing from year to year (Table 11, Figure 25)

Table 11. Mining industry percentage in Mongolia's economy

Year	2003	2004	2005	2006	2007	2008	2009
	percentage, %						
GDP	12.7	17.3	18.0	30.0	30.0	28.2	28.2
Total manufacturing products	49.6	64.7	65.5	72.0	69.1	64.6	65.3
Total export products	58.9	70.8	75.8	67.9	78.4	80.7	84.6

As of 2009, the mining industry produced 30 percent of the GDP, 65.3 percent of total manufacturing products and 84.6 percent of export products. It constitutes some 40 percent of state and local area budget income.

The Government supports the following measures: to use new natural resource deposits, to conduct technological renovation at existing industries and to make final products. For example the objectives until 2021 are: to construct copper melting industry; to produce cathode copper by enriching and dissolving copper ore; to process molybdenum concentrate; to process iron ore and its concentrate; to establish metallurgical complex; to produce phosphorite fodder; to enrich uranium by using uranium deposit; to research possibilities to produce energy; to obtain final products from e-technology purpose rare earth deposits. The distant objectives are to construct industries that make final processing of base metal concentrate and metal separation.

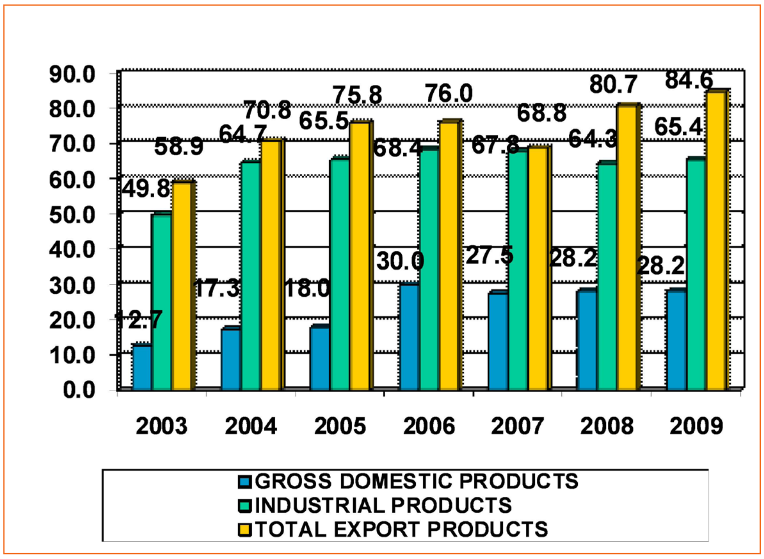

Figure 25. Mining sector percentage in Mongolian economy

Table 12. Strategic important natural resources deposits approved by the parliament

№	Deposit name	Location (aimag, soum)	Resources
1	Tavan Tolgoi	Tsogttsetsii, Umnugovi	6.42 billion ton coal
2	Nariin Sukhait	Gurvantes, Umnugovi	90.79 million ton coal
3	Baganuur	Baganuur, Ulaanbaatar	512.8 million ton coal
4	Shivee ovoo	Shiveegovi, Govisumber	564 million ton coal
5	Mardai	Dashbalbar, Dornod	1104 ton uranium
6	Dornod	Dashbalbar, Dornod	58933 ton uranium
7	Gurvanbulag	Dashbalbar, Dornod	16073 ton uranium
8	Tumurtui	Khuder, Selenge	229.3 million ton iron ore
9	Oyu Tolgoi	Khanbogd, Umnugovi	45 million ton copper, 1838 ton gold, 401000 ton molybdenum, 12000 ton silver
10	Tsagaan Suvarga	Mandakh, Dornogovi	1.28 million ton copper, 43.6 thousand ton molybdenum
11	Erdenet	Erdenet, Orkhon	3.2 million ton copper, 90 thousand ton molybdenum
12	Burenkhaan	Alagerdene, Burentogtoh, Khuvsgul	40.5 million ton phosphorite
13	Boroo	Bayangol, Selenge	22 ton gold
14	Tumurtuin Ovoo	Sukhbaatar, Sukhbaatar	820 thousand ton zinc
15	Asgat	Nogoonnuur, Bayan-Ulgii	2247 ton silver

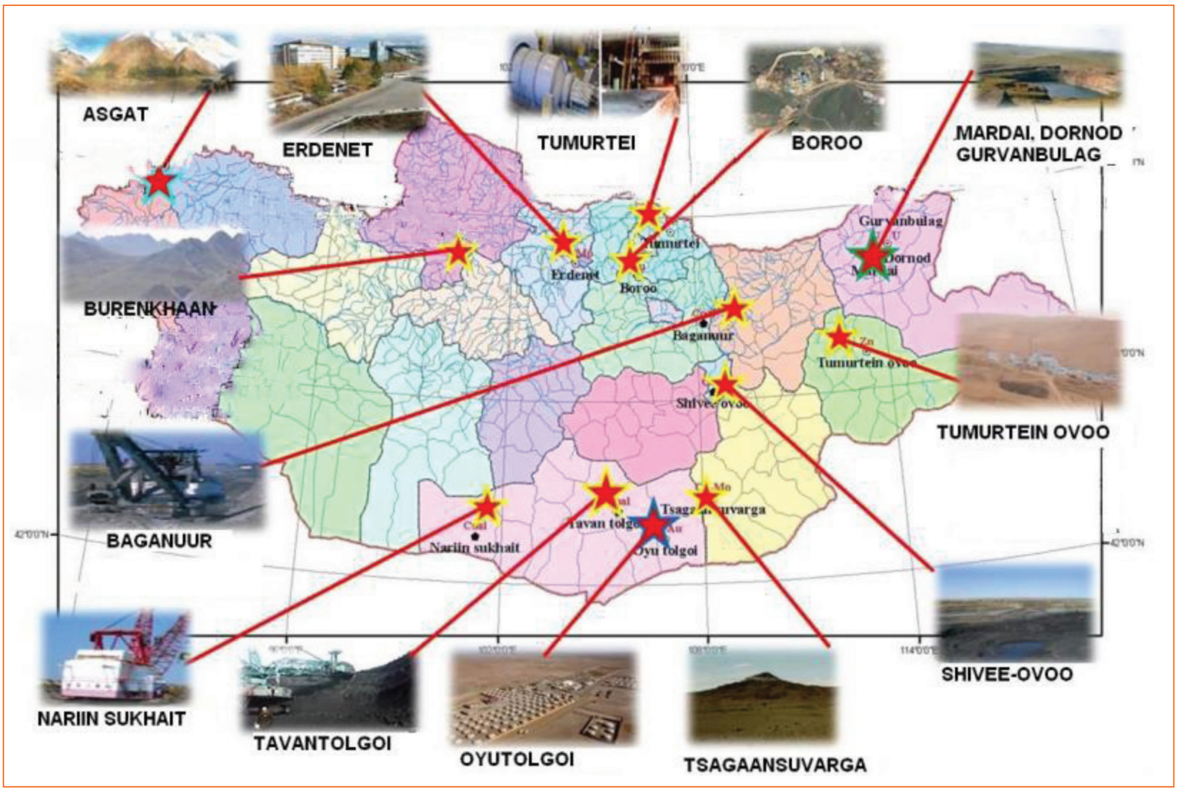

Figure 26. Location of Mongolia's main mines

It is clear that strategic natural resource deposits will be used first. This is reflected in the policy document approved by the parliament.

Oil extraction started in Mongolia in 1998 as a test. The extracted oil is exported to China by railway from the Tsagaan-Els deposit of Zuunbayan, Dornogovi aimag and by vehicle from Toson-Uul deposit of Matad, Dornod aimag. As of 2010, 7 foreign and domestic companies are operating in 10 oil research field. According to NSO data, 2.2 million barrel oil was extracted and 2.1 million barrel oil was exported in 2010.

Much water is needed in mining industries. It is important to treat not less than 70 percent of big mines production waste water or accumulate in ponds and clarify it. Then it will be reused.

Figure 27. River water is polluted due to gold mining

The mining deposits are located not close to urban centers and located in areas where water resources are scarce. Water is used: to wash and to enrich coal and ore; to cool drill front of drilling machine; dust prevention; to wash and to clean wastes and for mining workers' drinking water supply. Both groundwater and surface water are used for mining. Since 2005, the Water Authority made water use contracts with all mining companies according to the "Law on Water". Extracting natural resources are very beneficial to our country economy. But, extracting gold, sand and gravel in flood channel and rivers is having negative impacts on the river ecology and environment. It also pollutes the water.

Figure 28. Extracting sand and gravel in flood channel

The parliament approved a new law in 2009 in order to protect runoff forming water sources and water bodies: Law on Prohibition of Natural Resources Exploration and Mining Activities in River Source Where Its Runoff Originates, Protection Zone of Reservoir Area and Forest Resource Area. According to this law, relevant ministries and monitoring organizations conducted surveys of companies operating in river source forming parts and along rivers and mining licenses have been terminated.

Mining water users do not pay attention to improve water quality, to obey water use norms and use water efficiently. The mining companies are required to focus on the following: reuse water, keep water quality at approved level and pay attention to water losses. It is appropriate to stop fruitless activity to discharge water from mining.

The Government is planning to construct oil and natural resources processing heavy industries in Darkhan and Sainshand cities to use above mentioned strategic deposits. The following deposits will be in use soon. They include: Tsagaan Suvarga copper deposit; coal deposits of Nariin Sukhait, Choi-Nyalga and Tsaidam; uranium deposits of Mardai and Gurvan Bulag; Tsav lead (plumbum) deposit; Tumurtein iron ore deposit and Asgat silver deposit.

A 300 megawatt thermal power plant is scheduled to be constructed at Tavan Tolgoi. The industries that wash, process and extract 15 million ton coal each year from the Tavan Tolgoi deposit will be constructed. Our country's oil extraction is conducted by companies ("Petrochina Dachin Tamsag (Mongolia)", "Donshen Oil (Mongolia)") that have 100 percent Chinese investment. "Petrochina Dachin Tamsag" will extract 1.23 million ton oil (9.2 million barrels) from "Toson Uul-XIX" and "Tamsag-XXI" fields in 2013.

It is planned that the above mentioned deposits' water supply will be provided from nearby groundwater sources. But it is required to take water from distant areas. The reason is that there is no aquifer nearby.

The water resources research was conducted and pipelines construction started in 2007 in order to solve the water supply of Oyu Tolgoi and Tavan Tolgoi deposits that will be in use in 2013. The competent authorities gave permission to use water for the two deposits. Oyu Tolgoi will be supplied from "Gunii Khooloi" which is 50 km from the deposit. Tavan Tolgoi will be supplied from groundwater of "Balgas Ulaan Nuur" which is 70 km from the deposit.

It is a process of solving near future water supply issues. It is inevitable that there will be requirements to construct new water sources. The transfer and use of surface water is an option also.

2.3.5. Construction industries

The parliament approved "New Development" mid-term objective program in 2010. Until the end of 2016, some 100.000 household apartments will be constructed. The Government is implementing the program "Ulaanbaatar city Ger Districts' Apartment".

Source: NSO, 2012

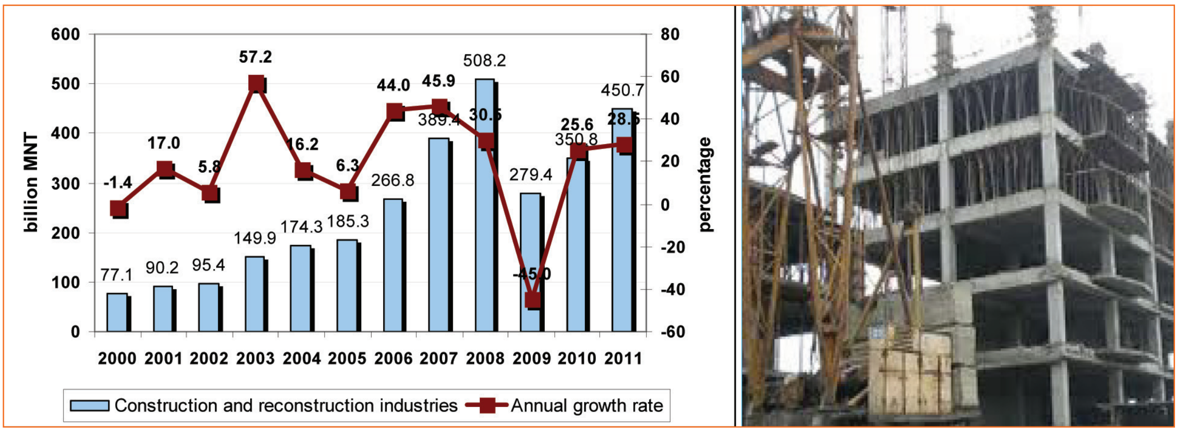

Figure 29. Construction industry

The increase in economic development has resulted in a big increase in industries involved in manufacturing construction materials required for the construction work. These industries are found in many urban centers but the majority is found in or near Ulaanbaatar as the main building activities take place here. The water supply of these industries is often organized privately but water is also obtained from the centralized water supply networks. Much water is used at construction sites.

Since 2007, concrete industry is introduced to our country. Concreted is produced at the industry and carried to the construction site by special purpose vehicle. Modern construction technology was introduced, construction quality was improved and the construction period was extended.

Figure 30. Concrete industry

However there is no detailed research on construction material industry water supply. Construction site water supply is from the centralized network and from transported water. The industries that produce concrete, concrete material, bricks, blocs and panels are supplied from their own boreholes. Most construction material industries do not have their own waste water treatment facilities.

2.3.6. Recommendations on industrial water supply

- New industries are using up-to-date technologies which use water more efficiently than old industries. Old industries with old machines and equipment should be replaced to increase water use efficiency and to decrease water pollution.
- As for industrial water supply, most industries in cities are supplied from centralized water supply and some industries have their own water source. Information and data are scarce on what percentage of urban industries are supplied from centralized networks and what percentage of urban industries are supplied from their own sources. It is difficult to make detailed report and data.
- Increasing industries' water use and waste water fees will play a key role in investment to introduce new technologies to improve water use efficiency. Reusing water will dramatically decrease water use.
- It is important to take measures to stimulate industries to reuse water efficiently with modern technology. Industries that use old technologies for mining, use water resources inefficiently, cause pollution, violate water use regime and cause negative impacts on water eco environment should pay a high water polluting fee and carry responsibility.
- It is important to include water supply and waste water treatment facilities in the construction design of the mining industry, light and food industries and construction industries.

- Mining industries are the largest water users of the industrial water users. As for some mines, water resources are very limited. It is important to plan water supply issues before starting to use the mines.
- Supplying mineral resources and energy sector industries with sufficient water in a stable way is a state policy. The implementation management of the state policy is to base capacity and potential on the water resources. So, it is important to know the potential exploitable water resources. The following needs to be done: water resources assessment should be conducted at each recharge zone and basin; water resources used for big industries should be determined; determine lowest and highest limit of the industrial water use and guarantee the supply of the lowest limit volume.
- Technical and economical studies are being conducted to increase the South Gobi water sources by way of diverting Orkhon and Kherlen river water. These projects impact on river ecosystems and environment and require much investment and operation cost. It is required to conduct the project's technical and economical research and calculation in a detailed way.
- A garbage recycling industry is being constructed at Ulaan Chuluut dump near Ulaanbaatar city. It is important to decrease the garbage related water pollution.
- A rule is needed to refuse permission to use water by industries that do not conduct water source assessment and do not have an approval by a professional council.
- Kharkhorin and Guulin hydropower plants have been constructed using a pressure pipe, station building and drainage channel. It gave a possibility to decrease investment dramatically. Using a water channel is the cheapest method to supply soum and urban areas which are distant from centralized energy systems with electricity in warm seasons. Also it is the cheapest method to generate limited power which is enough for the consumers.
- Survey and monitoring of hydropower plant water use is required. Local area administrative units should implement and manage monitoring of all industrial water use.
- The geological condition and technology of each mining industry is different. It is appropriate to establish water use norms at each industry by the way of measuring the water use directly. If possible, water use should be metered.
- Many mining industries decrease groundwater levels and excavate minerals with the help of drainage facility. By doing so, there may be negative impacts on certain areas' water bodies and eco environment of soil and plant cover. It is possible to take water use fee from mining factories that drain groundwater and discharge it.
- In order to improve industrial water supply management, a database should be created that contains all factories and indicators which are useful for determining their water supply management correctly and conducting monitoring.
- During the water use process, monitoring needs to be continuous and regulated of: water use condition, natural and damaged regime of surface and groundwater resources and water quality pollution.

2.4. Water supply for tourist facilities, green areas and transport

2.4.1. Water supply for tourist facilities

Tourism is developing rapidly in Mongolia during the last few years and its percentage in the GDP is increasing as well. Mongolia is a place where nomadic culture originated and prevails. In 2010 in total 456.3 thousand tourists visited the country, almost double compared with 2005.

The policy to develop tourism as leading sector until 2021 was formulated in the MDG-based Comprehensive National Development Strategy, which was approved by the parliament in 2008. Within the framework of this policy, Mongolia will be a global tourist hub by the way of developing tourism in each region, constructing large tourism complexes and developing infrastructure for tourism. By 2015, tourist number will reach 1 million.

The following things play a key role for the development of tourism sector. They are: "National Direction on Tourism Development" approved by the Government in 1995; "Master Plan to Develop National Tourism in Mongolia" approved in 1999; "Law on Tourism" approved by the parliament in 2000.

The tourism region is divided into 5 parts in the master plan to develop national tourism in Mongolia (2005-2015). They include: Gobi Gurvan Saikhan, Kharkhorin, Gorkhi-Terelj, Khuvsgul and Ulaanbaatar.

Kharkhorin-Orkhon part plays a key tourism role in Khangai region. The Government is planning to construct large tourism facilities in these regions and to develop infrastructure.


Figure 31. Tourist camp

Drinking water supply and sanitation is one of the basic conditions to have comfortable service for tourists. Mostly, tourist camps have boreholes in their own area and pipelines are connected to restaurant and sanitation from the boreholes. As for Mongolia, tourist facility includes hotels, tourist camps and sanatorium.

Figure 32. Sanitation and washing facilities of tourist camp

Hotels and motels (Bed and Breakfast) in cities are connected to the centralized water supply networks.

Table 13. Tourist camp numbers in Mongolia

Aimag name	Number	Aimag name	Number
Arkhangai	23	Uvurkhangai	15
Bayankhongor	2	Umnugovi	21
Bayan-Ulgii	6	Sukhbaatar	3
Bulgan	32	Selenge	13
Gobi-Altai	1	Tuv	52
Dornogovi	6	Uvs	5
Dornod	4	Ulaanbaatar	29
Dundgovi	17	Khovd	17
Zavkhan	1	Khuvsgul	50
Orkhon	1	**Total**	**312**

The national program "Tourism" plans to increase the number of tourists to 1 million in 2015 and 2.5 million in 2021. The national policy aims to accelerate the development of tourism by improving the quality of services and diversification of the attractions.

2.4.2. Water supply for green areas

In recent years, measures to establish parks and city street lawns and to plant trees have been intensified in a purpose of creating comfortable ecological environment for urban residents.

The New Development mid-term objective program was approved by the parliament in 2010. Not less than 20 percent of total areas, where new sub districts are constructed, will have green areas; 2300 ha ger district area and 1200 ha public area will have lawns and forests.

Figure 33. Green area landscape

The garden area size per capita must be used as urban planning standard.

According to Ulaanbaatar city statistical data as of 2010, 7139.3 thousand m^2 area was gardened in Ulaanbaatar city in 2010; 3625.9 thousand m^2 area was planted with grass (lawn) and 2828.1 thousand trees were planted. The big garden has been established in Darkhan city and much money is spent on establishing green areas in Erdenet and other aimag centers. The cities' green area irrigation is conducted between April 1 and August 1 of each year. Water is used much for the irrigation in this period.

Figure 34. Lawn and green area irrigation

There is no special water source for green areas in Ulaanbaatar and other cities. Water for green areas is supplied from centralized drinking water pipelines. As for Ulaanbaatar city, soil water is piped and green areas are irrigated with the help of sprinkler pump stations. Water sprinkler trucks are used for irrigation of lawns and trees along roads and on squares.

Some parts of garden and lawn area are irrigated by irrigation systems. Some organizations irrigate their surrounding garden and lawn area by using flexible pipes, small size portable sprinkler machine from their drinking water, sometimes they irrigate manually.

"Tsetserlegjilt" company is responsible for green area irrigation in Ulaanbaatar city. The development and service companies are responsible for green area irrigation in other cities.

Data on green area irrigation is scarce.

"Green Wall Program": The Government approved it in 2004. In 30 years time, a green line will be established in the frontier of Gobi and steppe zones in order to prevent sand moving and desertification which connect west and south. The width of the line "Green Wall" or "Ecotrass" is not less than 600 m and the length is more than 2500 km. The area will be more than 150 thousand ha. Some parts of the following aimags will be included in terms of the location: aimags that are located in Gobi and steppe regions including Khovd, Gobi-Altai, Bayankhongor, Uvurkhangai, Umnugovi, Dundgovi, Dornod, Dornogovi, Govisumber, Khentii and Sukhbaatar.

The width of auxiliary green line that prevents from sand moves and desertification, directed southeast from west of vertical axis in the south of Gobi and steppe regions, is planned to be not less than 430 m. The length is planned to be more than 1200 km. The area will be more than 50 thousand ha. Some parts of following aimags will be included. They are some parts of Ulaanbaatar, Bayan-Ulgii, Uvs, Khovd, Zavkhan, Bulgan, Tuv and Dornogovi.

The "Green Wall" program will be implemented by 3 stages. The first stage is between 2005 and 2015, 20 percent of the objectives; second stage is between 2015 and 2025, 30 percent of the objectives; third stage is between 2025 and 2035, 50 percent of the objectives. The implementation of the program faces difficulties due to management and financial issues.

Within the framework of the program, trees were planted at 535 ha area between 2005 and 2007; and at 809 ha area between 2008 and 2010 (Table 14).

Table 14. Forest line established within the framework of "Green Wall" national program.

№	Aimag name	2008		2009		2010	
		Area, ha	Survival , %	Area, ha	Survival , %	Area, ha	Survival , %
1	Bayankhongor	15.0	82.0	10.0	81.5	5.0	93.5
2	Bayan-Ulgii	10.0	90.0	5.0	80.0	10.0	80.0
3	Bulgan	10.0	85.0	10.0	75.0	5.0	75.0
4	Gobi-Altai	30.0	84.6	10.0	85.0	10.0	77.7
5	Govi-Sumber	10.0	95.0				
6	Darkhan-Uul						
7	Dornogovi	15.0	87.5	10.0	78.2	8.0	75.6
8	Dundgovi	15.0	84.0	12.4	84.0	10.0	82.0
9	Dornod	20.0	86.0				
10	Zavkhan	20.0	85.0	10.0	92.0	8.0	88.4
11	Orkhon						
12	Uvurkhangai	25.0	80.0	10.0	79.0	5.0	81.8
13	Umnugovi						
14	Selenge						
15	Sukhbaatar	15.0	75.0	5.0	77.2	5.0	78.3
16	Tuv			5.0	85.0	5.0	84.0
17	Ulaanbaatar	15.0	78.0	10.0	79.4	10.0	77.8
18	Uvs	27.5	93.6	15	95.9	10.0	96.1
19	Khentii	10.0	90.0	5.0	90.0	5.0	76.0
20	Khovd	27.5	89.5	15.0	87.0	10.0	92.1
21	Aid	206.0		100.0			
	Total	**471.0**		**232.4**		**106.0**	

The program implementation is bad in Gobi and steppe zones due to water supply issues of "Green Wall" program.

Figure 35. Trees planted within the framework of "Green Wall" program and constructed reservoir

The Gobi zone residents and entities plant trees in order to support the implementation of "Green Wall" program. Water is carried from boreholes/kiosks and it increases cost and cause difficulty. In 2010 the government approved the ''Sea-buckhorn'' Program and the first stage of the total 20,000 hectares will be implemented in 2011-2016. According to the presidential decree on "Announcement of Tree Planting National Day" of 2010, trees were planted at 1265.2 ha area in 2011. According to "Sea-buckthorn" program approved by the Government, sea-buckthorns were planted at 1000 ha area. Within the framework of "Green Wall" national program, forest line was set at 305 ha area by the finance of state budget and other sources. As of 2011, total of 10926.5 ha area was forested and rehabilitated.

2.4.3. Water supply for roads, railways and transport

Roads: In 2001, the parliament made a resolution on "Approval of Millennium Road and Infrastructure Vertical Axis". The parliament approved main horizontal axis and vertical axis road directions of Mongolian infrastructure. The horizontal axis road goes to following urban areas to the west from Ulaanbaatar: Lun ~ Dashinchilen ~ Ugiinuur ~ Battsengel ~ Ikhtamir ~ Khanuin Guur ~ Tariat ~ Tsakhir ~ Tosontsengel ~ Telmen ~ Uliastai ~ Zavkhanmandal ~ Durgun ~ Myangad ~ Ulgii ~ Tsagaannuur~ to the border. To the east from Ulaanbaatar: Nalaikh ~ Bayandavaa ~ Erdene ~ Baganuur ~ Undurkhaan ~ Bayan-Ovoo ~Tumentsogt ~ Khulunbuir ~ Bulgan ~ Choibalsan ~ Sumber ~ to the border.

Vertical axis roads 1) From Borshoo port to Yargait port via Ulaangom and Khovd, 2) From Khankh port to Burgastain port via Murun, Uliastai and Altai, 3) From Baga-Ilenkh port to Shivee Khuren port via Bulgan, Kharkhorin, Arwaikheer and Bayankhongor, 4) From Altanbulag port to Sainshand and Zamiin Uud ports via Sukhbaatar, Darkhan, Ulaanbaatar, Choir, Mandalgovi, Tavan Tolgoi, Dalanzadgad, 5) From Ereentsav port to Bichigt port via Choibalsan and Baruun urt. These areas will be connected by black top road.

Figure 36. Millennium road routes

In recent years, "Millennium Road" work is being conducted intensively. The local area and state budget and international organizations' loan investment, for the maintenance and construction of urban area roads, is increased each year.

Water is used a lot for compacting soil and fighting dust during road construction work. Water is carried by own water trucks from open river water. Data on water supply, which used for urban and rural road construction, is scarce.

Figure 37. Using water for road construction

Railway: In 2010, the parliament approved a policy document on "State Policy on Railway Transport" by the purpose of increasing railway transport capacity, expanding integrated domestic network of national railway which is for providing future transport demand, using big natural resources deposits, exporting their products, processing them and speeding Mongolia's socio-economic development as well as providing stable future development. 5683.5 km basic railway structures will be newly constructed period by period.

The first stage (total of 1100 km): Dalanzadgad – Tavan Tolgoi – Tsagaan suvraga – Zuunbayan (400 km), Sainshand – Baruun-Urt (350 km), Baruun-Urt – Khuut (140 km), Khuut – Choibalsan (150 km). The second stage (total of 900 km): Nariinsukhait – Shiveekhuren (45.5 km), Ukhaa Khudag – Gashuunsukhait (267 km), Khuut – Tamsagbulag – Numurug (380 km), Khuut – Bichigt (200 km). The third stage (total of 3600 km): new construction of western railway (railway in the western aimags).

Figure 38. Coal transport by railway

Much water will be needed when constructing the above mentioned railways. It is important to study when developing technical and economic basis and lay-out of water resources availability and required water supply for the construction. It is inevitable that there will be requirements to establish new water sources when settlement is formed along the road and railway and water demand is increased. Mongolian and Russian joint "Ulaanbaatar Railway" supply its workers and service water from boreholes which were drilled at each station. Ulaanbaatar railway water supply brigade is responsible for water supply of transportation, industry, population and organizations along the railway line.

Some parts of the following stations along the railway line are supplied from centralized networks. They are Zuunkharaa, Salkhit, Orkhontuul, Bagakhangai, Choir, Airag, Sainshand, Ulaan-Uul and Zamiin Uud. As for Zamiin Uud and Choir stations, water resources are scarce. Also water quality is bad. The 18 km Ulaan-Uul (Erdene soum) station water supply pipeline was out of order in 1998 and water is supplied from Sainshand.

Transport: A new international airport is planned near Zuunmod at Khushigt valley. The water demand will increase a lot near this area. The Government is planning to construct transport logistics complexes at areas where there are road and railway stations (it will consist of the followings: facility to load from vehicle to railway, from railway to vehicles; warehouse to keep goods temporarily; data and communication networks; customs inspection field and warehouse; customs inspection service spots; laboratory of professional inspection; banks; post office; hotels; other business areas; dedicatory road and field).

These facilities' water supply issues have not been solved yet. It should be studied in detail in the phase of technical and economic basis as well as lay-out development. In recent years, the living standard of people is increased and the number of vehicles in urban and rural areas is increased. Many car wash centers are established and they use much water. Washing one vehicle with high pressure water in a car wash center, 500 l water is used. It would be appropriate to increase their water fee in order to let them use water more efficiently.

3. Hydro constructions

Hydro constructions include facilities that regulate, abstract, accumulate, store, transfer, distribute, purify and treat water and that prevent from water damage. This chapter contains brief descriptions of: flood protection constructions, hydropower plants, dams for irrigation systems, and facilities to accumulate rain and snow water.

There is a separate report on waste water treatment plants.

3.1. Flood protection constructions

The flood protection construction is a facility that is built to protect urban areas and important infrastructure from flood damage. The following are urban areas and places where flood protection constructions are built. They are: Ulaanbaatar, Darkhan, Erdenet, Uliastai, Sukhbaatar, Bulgan, Ulaangom; Sukhbaatar city railway station, Ulaanbaatar city "Chingis Khaan" international airport, new airport in Umnugovi aimag and airport in Uvurkhangai aimag. In some soum centers, flood protection constructions are built. The aimags, cities, soum centers, airports and railway stations with flood protection constructions are presented in Table 15.

Table 15. Urban areas and infrastructure with flood protection dykes and channels

City	Aimag center	Soum center	Infrastructure
Ulaanbaatar, Darkhan, Erdenet	Tsetserleg, Bulgan, Altai, Uliastai, Zuunmod, Sukhbaatar, Ulaangom, Khovd, Murun, Arvaikheer	Bulgan aimag Khangal, Gobi-Altai aimag Altai, Delger, Chandmani, Tuv aimag Bayan Tsogt, Selenge aimag Zuunburen, Uvs aimag Turgen, Khovd aimag Bulgan, Buyant, Uyench, Khuvsgul aimag Erdenebulgan (new)	Chingis khan airport in UB city, Umnogovi and Uvurkhangai aimag airports, Sukhbaatar city railway station

In recent years, due to climate change, it becomes warm early in spring and heavy rains occur in summer. It increases possibility of flood damage. The flood is a natural disaster that kills people and destroys properties. The flood frequency is increasing at Ulaanbaatar and at national level.

The first flood protection construction survey started after the 1966 flood in Ulaanbaatar. The lay-outs were developed and construction work was intensified. There was a flood in 1982 caused by heavy rain of August. The Chingeltei mountain area was impacted in the flood. Then extra flood protection constructions that prevent from small river floods were constructed.

As of 2010, there were 42 km flood protection concrete dykes, 56 km river protection dyke, 9.8 km earth dyke, 3.5 km dyke with internal stone layer, 6 clarifiers that receive flood water and road rain water (3 clarifiers with 9800-10.300 m^3 capacity and 3 clarifiers with 200-250 m^3 capacity), 18 collectors that discharge soil water and 70 km water drainage underground pipes were constructed.

Ulaanbaatar city flood protection facilities:

1. Baruun Uul flood protection facility, it includes Denjiin Myanga flood protection channels, channel from "32 Toirog" and Nogoon Nuur to Dund Gol, 3rd and 4th mini-districts and Tolgoit flood protection facilities.
2. Selbe river flood protection facility includes flood protection facilities of Chingeltei, Khailaast and Belkh rivers.

3. Zuun Uul flood protection facility includes: rain water and snow which came down by Tsagaan Davaa and Shar Khad area natural dry river bed is accumulated and is flown through hidden channel. It passes through water-speed-decreasing well/kiosk and it is connected with gorges protected by earth dam in the west side of Bayanzurkh district police department. It flows into Tuul River by the tunnel under the Narnii Zam and railway.
4. Tuul river flood protection facility includes Uliastai River and northern dam of Tuul river flood protection.
5. Zuun Naran flood protection facility includes earth dam on west and east side of the Tolgoit oil station, dam in the end of Baga Naran dry river bed.
6. Baruun Naran flood protection facility includes earth dam which directs flood water from Ikh Naran and Bayangol, water drainage facilities under the railway and autoroad.

There were floods in Ulaanbaatar city in 1966 and 1982. They caused a lot of damage. 87 people were killed during the flood in 3rd and 4th mini-district, Khailaast and Chingeltei in 1982 in Ulaanbaatar city.

Figure 39. Flood in Ulaanbaatar in July, 2009

Due to the flood, flood protection dykes, channels, bridges, water drainage facilities are damaged a lot. The flood dams are cracked open due to state of being not maintained. The reinforcement concrete panel and stone reinforcement are broken and collapsed. Especially, Khailaast and Chingeltei flood protection dykes should be rehabilitated and improved.

Figure 40. Khailaast flood protection dyke

Figure 41. Chingeltei flood protection channel

Figure 42. Tuul river flood protection dyke

Figure 43. Uliastai river flood protection channel

In recent years, flood protection facilities are being rehabilitated and constructed by state, Ulaanbaatar city and local area budget. As of 2012, 13.6 billion tugrugs was used from state and Ulaanbaatar budget for the new flood protection constructions. The new flood protection constructions range from Tolgoit, Ikh and Baga Naran and Peace bridge to Engles bridge. They are also constructed in Khaniin Material, 21st district of Songinokhairkhan district, Denjiin 1000, 3rd and 4th mini-district and Zaisan.

The ger district people put their garbage in flood channel. The accumulated garbage and sludge do not get cleaned in time and it decreases the capacity to conduct flood water. There are gers, fences and houses in flood channels and dykes. It increases the chance to get caught in floods.

Figure 44. Cleaning of flood protection channel

The Darkhan city general planning was made with flood protection facilities. There are 3 earth and concrete flood protection channels in Darkhan city. They are industrial region flood protection channel, New Darkhan flood protection channel and Old Darkhan flood protection channel. There are 36.3 km channel altogether.

The Zuun Uul flood protection facility of Darkhan city was newly constructed in 2002.

Tsetserleg city flood protection channel was constructed at north side of the hill, near Khalzangiin Davaa, southwest of the aimag center in 2007. The aimag authority considered that it is not a good solution and did not put it into use. The reason is that there is high possibility of flood water coming through Tsagaan Davaa and Arslantai Tsohio at the north side of aimag center.

Figure 45. Sediment accumulation pond

Figure 46. Flood water drainage channel

By the purpose of protecting Bulgan city center and ger district households from flood, the following activities are being conducted: let the flood water flow along the road; let pass flood water cross northern part of the city; construct channels with internal layer of stone and concrete and renovate and expand old channels.

Figure 47. Tsetserleg and Bulgan city flood protection channel

The mountain flood protection dyke and channel of Sukhbaatar city were constructed at northwest and north of the city along the railway. The dykes along the railway were renovated by foreign investment between 2000 and 2002. The dykes have concrete reinforcement. 3428 m channel of northern part of the city did not receive maintenance for the last 15 years. So, it is impossible to let pass flood water. It is required to develop new lay-out and renovate the channel.

It is required to develop new lay-outs of the flood protection dykes and facilities in the following areas: aimag centers of Gobi-Altai, Uvs, and Khuvsgul; Khangal of Bulgan aimag; Chandmani of Gobi-Altai aimag; Zuunburen of Selenge aimag; Turgen of Uvs aimag; Buyant and Uyench of Khovd aimag. Also renovation and maintenance are required.

There are total of 93.5 km long dykes and 84.2 km long channel in Mongolia and data on these dykes and channels is rare. “Hydro Construction” Ulaanbaatar owned company is responsible for flood protection facilities in Ulaanbaatar. The aimag and soum governor’s office is responsible for flood protection facilities in other aimags and soums.

Recommendations on flood protection facilities:

- The common reasons of flood protection construction breakdown are: bad quality construction, hydrotechnical construction usage period is not well calculated, very poor use condition due to no ownership, insufficient in terms of reflecting different reinforcement elements in the design, no laboratories to test use condition and design of flood water passing facilities, when developing designs, modern materials and design were not used, survey on previous facility breakdown was not conducted.
- The integrated measures, to protect Ulaanbaatar city from river flood, soil water and road flow were planned in the general plan of Ulaanbaatar city until 2020. But the implementation is insufficient.
- Flood channel and sedimentation pond near Denjiin Myanga and Nogoon Nuur of Ulaanbaatar city are filled with mud and ger district household wastes during the flood. The flies, mosquitoes, and insects breed. It has negative impacts on social hygiene and it causes infectious diseases.
- The capacity of flood water channels is low. It is unable to hold certain part of the flood water. It constitutes the situation where the city is impacted by flood water. Khailaast and Chingeltei flood protection dykes and channels of Ulaanbaatar city should be renovated.
- In 2010 flood, Yarmag, Nisekh, Biokombinat area was affected by the flood water. The old flood protection constructions should be renovated. New ones need to be constructed as well.
- The flood protection constructions of Ulaanbaatar city, aimag and soum centers are broken and outdated. They are not prepared for potential flood, spring yellow water flood and downpour.
- The high level facility should be constructed which protects from flood damage and let pass flood water that can happen in 100 years. The unresearched small rivers with small water accumulation field and their maximum flow near aimag and soum centers will be calculated. The high level facility will be constructed according to design which has the most prudent technical solutions.
- The rural people moving to cities live illegally in dry river beds and valleys. They do not respect local area authority decisions. It is important to establish legal structures that terminate the old habit to receive financial support from the state after the flood.
- The current condition of flood protection constructions shows that new management should be organized which covers: conducting research to protect urban area population and possessions from rain water and river water floods; developing general scheme and owners who take care of use and maintenance.
- It is required to conduct research works that determine the general design of flood protection construction, construction quality, foundation, washing, water and ice impacts, temperature change, leakage from bottom and sides of the facility, leakage pressure impact, basic soil water impact, flood protection constructions and river watercourse feature and interactions, basic soil move, accumulation and washing.

3.2. Irrigation systems and hydropower plant facilities

3.2.1. Irrigation systems

An irrigation system is a complex facility that includes hydro constructions and equipment which accumulate, transfer, distribute water in order to irrigate crops and pasture and discharge excessive water.

The dam is a facility which regulates river watercourse by blocking river in a crossed way. The dam is classified by its design as earth, stone and earth, and concrete.

Our country's irrigation system dams are mainly earth dams. The Khaya irrigation system dam of Tsogt soum of Gobi-Altai aimag is 36 m in height or it is the highest irrigation system earth dam (artificial lake volume is 3.9 million m^3).

Figure 48. Khaya earth dam and artificial lake

Earth dams were constructed at some 10 irrigation systems before 1990. For example: Baruunturuun, Uvs (8.3 million m^3); Bornuur, Tuv (2.7 million m^3) and Jargalant, Tuv (2.5 million m^3).

Dams were constructed to accumulate river water with the aid of headworks and by branching river water at: Yolton in Khaliun soum of Gobi-Altai aimag, Deed Choibalsan in Bayantumen soum of Dornod aimag (Table 16).

Table 16. Big irrigation system dams and reservoirs

Aimag name	Soum name	№	Irrigation system name	Date of start-up	Location		Dam data		
					Latitude	Longitude	Height m	Length m	Capacity thousand m^3
Uvs	Baruunturuun	1	Baruunturuun	1974	49° 37' 33.61"	94° 22' 38.85"	17.6	260.0	8 300.0
	Naranbulag	2	Teeliin Boom	1984	49° 54' 52.76"	92° 14' 06.69"	6.0	180.0	90.0
	Ulaangom	3	Ulaantolgoi	1979	49° 59' 31.95"	92° 00' 44.80"	6.7	2000.0	91.0
Gobi-Altai	Bugat	4	Bij	1976	45° 54' 20.56"	96° 24' 53.54"	17.5	470.0	1 200.0
	Khaliun	5	Yolton*	1972	45° 52' 19.18"	96° 26' 22.05"	7.0	300.0	197.0
	Jargalant	6	Teeliin Bulag	1973	46° 58' 38.8"	95° 49' 50.6"	9.5	840.0	85.0
	Taishir	7	Khurimt	1971	46° 47' 45.3"	96° 44' 33.7"	7.1	285.0	350.0
	Tsogt	8	Khaya	1971	45° 15' 07.49"	96° 16' 03.74"	33.0	346.0	390.0

Aimag name	Soum name	№	Irrigation system name	Date of start-up	Location		Dam data		
					Latitude	Longitude	Height m	Length m	Capacity thousand m³
Uvurkhangai	Taragt	9	Arwain Tal	1978	46⁰ 16ˡ 50.81ˡˡ	102⁰ 28ˡ 30.12ˡˡ	8.0	350.0	700.0
	Tugrug	10	Mazar	1976	45⁰ 43ˡ 33.22ˡˡ	102⁰ 51ˡ 04.49ˡˡ	2.5	300.0	5.4
Tuv	Batsumber	11	Mandal	1976	48⁰ 14ˡ 45.43ˡˡ	106⁰ 45ˡ 07.56ˡˡ	5.0	470.0	37.8
	Bornuur	12	Bornuur	1967	48⁰ 26ˡ 45.29ˡˡ	106⁰ 13ˡ 22.28ˡˡ	11.8	480.0	2 700.0
	Jargalant	13	Jargalant	1961	48⁰ 28ˡ 57.55ˡˡ	105⁰ 53ˡ 33.37ˡˡ	15.0	490.0	2 500.0
	Batsumber	14	Udleg	1971	48⁰ 16ˡ 07.98ˡˡ	106⁰ 48ˡ 56.34ˡˡ	9.7	620.0	38.6
Umnugovi	Dalanzadgad	15	Dalanbulag	1975	43⁰ 33ˡ 09.67ˡˡ	104⁰ 25ˡ 17.41ˡˡ	4.5	387.0	25.0
Dornod	Bayantumen	16	Deed Choibalsan*	1989	48⁰ 02ˡ 37.59ˡˡ	114⁰ 09ˡ 58.80ˡˡ	5.9	400.0	3 100.0
Total									19 809.8

*Note: * Reservoir without dam*

Figure 49. Irrigation system head works and reservoir, artificial lake

Sprinkler irrigation has advantages including normalizing irrigation water and easy water supply needed for plants' growth period. It saves labor force and does not cause soil ecological damage.

Many different types of equipment are used for sprinkler irrigation. The following equipment was used: "Boljanka" sprinkler machine with electric and mechanic engine; "DDN-100A" and "DP-40" sprinkler machine with mechanic engine which was installed on tractors with chains and wheels; "Fregat" and "Dnepr" sprinkler machines which make circling moves with water pressure. Some of them are still used now.

"Gun" shaped sprinkler machines are installed on tractors. They were "DDN-40" and "DDN-70". Now Chinese made "BAUER" sprinkler is used widely. It has one to two sprinkling muzzles which are circled by water pressure moving in one direction by water pressure force.

Mongolia started to use sprinkler irrigation from 1969. As of 1990, there were 638 sprinkler machines with a capacity to irrigate 35 thousand ha area. 361 out of 638 sprinkler machines were modern machines.

"Fregat" sprinkler machine was used at 10.000 ha area in Kharkhiraa, Baruunturuun, Ulaan Khotgor of Uvs aimag; Yolton, Khaya, Shugui irrigation systems of Gobi-Altai aimag. It uses river water pressure force of high mountains and it is used without any gas, petrol and energy costs.

Figure 50. "Fregat" sprinkler machine which circles its axis

The entities with a small area use "BAUER" sprinkler machine for irrigation. The wheat entities with large areas use American-manufactured "Valley" and "T-L" design Fregat-like sprinkler machines for irrigation. Also Chinese-manufactured small size sprinkler machines are used. Its pipes are manually carried. The water is piped from river and channel water by diesel engine.

Figure 51. Sprinkler machine pumping station and US-made "Valley" sprinkler

Figure 52. Chinese-made "BAUER" and US-made "T-L" sprinkler machines

3.2.2. Hydropower plants

Our country has much water energy resource. But research works are insufficient and much attention is not paid for the use of water energy. The first hydropower plant was built on Kharkhorin irrigation system main channel of Uvurkhangai aimag in 1959 with Chinese technical aid. It had two turbines and the capacity was 528 kilowatt. It used to operate 6 months in warm seasons. It was used for 20 years without any maintenance. Its turbines and generators started breaking down since 1995.

A 200 kilowatt hydropower plant was built on Jigj river of Undurkhangai soum of Uvs aimag in 1989 by Vietnamese Government aid. In recent years, hydropower plants have been constructed and used in Bogd river of Zavkhan aimag; Guulin of Gobi-Altai aimag; Mankhan and Munkhkhairkhan soums of Khovd aimag; Ider river of Tosontsengel soum of Zavkhan aimag; Uyench river of Khovd aimag; Erdenebulgan of Khuvsgul aimag.

These low capacity hydropower plants provide rural towns with electricity and it shows that there are possibilities to use water energy. Two big dams are constructed at Durgun of Khovd aimag (artificial lake volume is 256 million m^3) and Taishir of Gobi-Altai aimag (artificial lake volume is 930 million m^3). A 150 kilowatt hydropower plant was constructed on Galuutai river of Tsetsen-Uul soum of Zavkhan aimag and a 110 kilowatt hydropower plant was constructed on Khungui river of Zavkhanmandal soum.

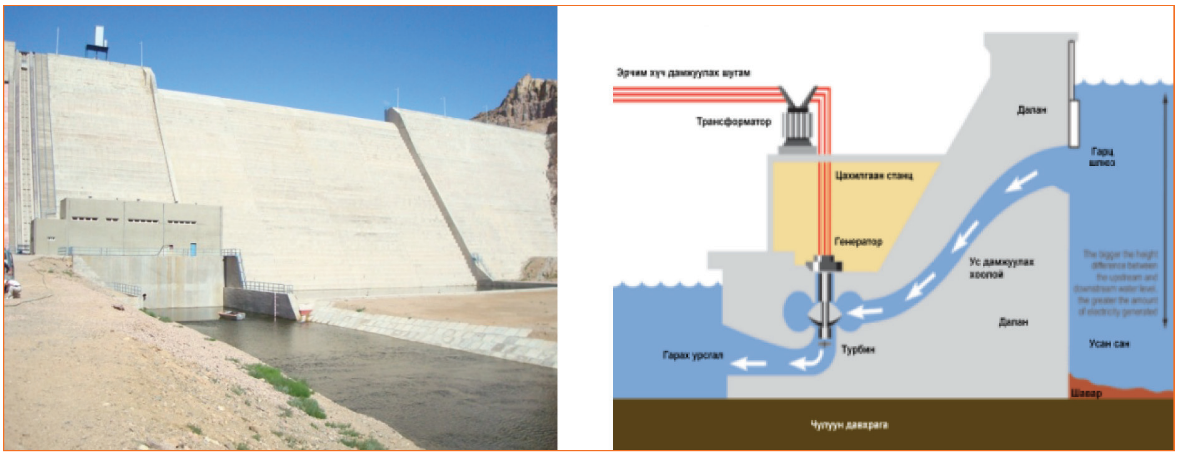

Figure 53. Taishir hydropower plant concrete dam and general scheme

Table 17. Hydropower plant-dam technical data

Aimag name	Soum name	№	Hydropower plant name	Date of start-up	Location		Dam data		
					Latitude	Longitude	Height *m*	Length *m*	Capacity of reservoir *thous m³*
Khovd	Durgun	1	Durgun hydropower plant	2010	$48^{0}\ 19^{I}$ 32.0	$92^{0}\ 48^{I}$ 27.6^{II}	18	231	256 000
	Uyench	2	Uyench hydropower plant	2005	$46^{0}\ 06^{I}$ 00.6^{II}	$92^{0}\ 02^{I}$ 44.9^{II}	16	210	1.5
Gobi-Altai	Taishir	3	Ulaanboom hydropower plant	2009	$46^{0}\ 41^{I}$ 41.7^{II}	$96^{0}\ 39^{I}$ 55.5^{II}	58.0	190	930 000

A 220 megawatt hydropower plant is going to be constructed on Eg River in Bulgan aimag. The feasibility study is completed. It will be used during the peak pressure of the central energy system. Other hydropower plants planned are: 90 megawatt hydropower plant in Erdeneburen of Khovd aimag, 100 megawatt hydropower plant on Orkhon River, 20 megawatt hydropower plant in Chargait of Khuvsgul aimag.

The technical and economic basis of the following hydropower plants has been developed and construction work is ready to be commenced: 400 kilowatt on Mungash River in Ulaan-Uul soum of Khuvsgul aimag; 400 kilowatt in Bulgan soum of Bayan-Ulgii aimag.

As of 2010, there are 13 high and low capacity hydropower plants in Mongolia. 9 low capacity hydropower plants are being used. The main data of these hydropower plants are presented in the table below.

Kharkhorin and Guulin hydropower plants have been constructed without a reservoir which decreases investments dramatically.

Table 18. Hydropower plants' technical solutions

№	Hydropower plant's names	Installed capacity, *kilowatt*	Construction design	Investment types
1	Bogd river	2000	With water channel	State budget
2	Guulin	400	From main channel of irrigation system	State budget
3	Mankhan	150	With water channel	State and local area budget
4	Munkhkhairkhan	150	With water channel	State budget
5	Undurkhangai	200	With water channel	Vietnamese technical aid , state budget
6	Kharkhorin	600	From main channel of irrigation system	Chinese aid
7	Uyench	960	With water channel	State budget
8	Tosontsengel	375	Weir	German grant
9	Erdenebulgan	150	With water channel	Danish government grant
10	Zavkhanmandal (Khungui)	110	With dam	German grant
11	Tsetsen-Uul (Galuutai)	150	With dam	German grant
12	Durgun	12 000	With dam	Foreign loan
13	Taishir	11 000	With dam	Foreign loan

Bogd river hydropower plant of Zavkhan aimag: it consists of headworks, water channel, pressure pipe, station building and drainage. It is connected to Uliastai city from the hydropower plant by 36 km long 35 kilowatt electricity transmitting lines.

Table 19. Main technical data of Bogd river hydropower plant

Installed capacity	2000 kilowatt
Length of water channel	2.5 km
Cross section of water channel	Trapeze
Calculated inrush/pressurizing	35m
Calculated discharge	7.0 m^3/sec
Turbine types	Prancis, HL240-WJ-71
Generator types	SFW-J1 000-10/143C

The technical solution of Bogd river hydropower plant design, construction quality and use condition are bad. It breaks down repeatedly and requires regular maintenance. The headworks, water channel, weir, pressure pipe and drainage channel of the hydropower plant have been renovated by a German grant since 2005.

Before that the hydropower plant capacity was no more than 800-1100 kilowatt. The net head was 32 m and discharge was 4.2 m^3/sec. The current condition can be seen in Table 19.

Figure 54. New and old channels

Figure 55. Geotextile and geomembrane lining on the inside of the channel

Figure 56. Drainage channel

Figure 57. Excessive water discharge

Figure 58. Water expulsion cell

Gobi-Altai's Guulin hydropower plant: a 400 kilowatt capacity hydropower plant constructed and put into use in 1998 by using main channel of Guulin irrigation system.

It consists of pressure pipe, station building and drainage channel.

Table 20. Main technical data of Guulin hydropower plant

Installed capacity	400 kilowatt
Calculated pressurizing/influx	40 m
Calculated discharge	0.87 m^3/sec
Turbine types	Prancis
Generator types	HL260-WJ-42

Figure 59. Main channel of Guulin irrigation system

Figure 60. Headworks for water distribution

Figure 61. Hydropower plant facility, pressure pipes, drainage channel

Figure 62. Hydropower plant turbine generator

Gobi-Altai's Taishir hydropower plant: According to the resolution number 13th of 2009 of management board of Altai-Uliastai Energy Systems company, Taishir and Guulin hydropower plants are integrated as "Taishir-Guulin hydropower plant" LLC.

Table 21. Main technical data of Taishir hydropower plant

Installed capacity	11 megawatt
Energy produce per year	37.0 million kilowatt hour
Total volume of reservoir	930.0 million m3
Water surface area	52.0 km^2
Highest point above river watercourse	50 m
Dam length	190 m
Assembly number 4 units	(3x3.45 megawatt+1x0.65 megawatt)
Maximum water discharge	(3x9.2+1x2.2) = 29.8 m^3/sec
Discharge with the maximum efficiency coefficient	(3x11.7+1x2.5) m^3/sec
Capacity	12.5 megawatt

Khovd's Mankhan hydropower plant: In order to provide Mankhan soum center with electricity, a low capacity hydropower plant with water channel was constructed on Tugrig River in 1998. The hydropower plant consists of a weir, water channel, pressure pipes, station construction and drainage channel.

Table 22. Main technical data of Mankhan hydropower plant

Installed capacity	150 kilowatt
Calculated influx/pressurizing; calculated discharge	13.8 m
Turbine types; generator types	0.87m^3/sec, Prancis, HL260-WJ-42, 5RCHCH-L 5-6/493

Figure 63. Sediment washing facility of Mankhan HPP

Figure 64. Water intake structure and sediment washing facility

Figure 65. Connection part to water intake structure 30 m stone concrete dam

Figure 66. Turbine generator

Figure 67. Reservoir spillway

Figure 68. Earth dam with stone coat at upper barrier, mud core in the middle

Khovd's Munkhkhairkhan hydropower plant: It was constructed in 2003 by state budget investment. It consists of headworks which was placed on junction of Senkher and

Uliastai rivers, weir, water channel, reservoir, pressurizing pipes, station construction and drainage channel.

Table 23. Main technical data of Munkhkhairkhan hydropower plant

Installed capacity	150 kilowatt
Calculated pressurizing	7.5 m
Calculated discharge	3.8/0.7/ m^3/sec
Turbine types	Carlan
Generator types	HL260-WJ-42

Figure 69. Two assemblies with vertical axis

Figure 70. HPP headworks' earth dam construction

Figure 71. Reservoir

Figure 72. Spiral chamber

Undurkhangai hydropower plant of Uvs aimag: It was constructed in 1989 with Vietnamese aid. It consists of headworks, water channel, reservoir, pressure pipes, station construction and drainage channel.

Table 24. Main technical data of Undurkhangai hydropower plant

Installed capacity	200 kilowatt
Calculated pressurizing	17.5 m
Calculated discharge	1.5 m^3/sec
Length of water channel	1.9 km
Cross section of water channel	Trapeze

Figure 73. Weir

Figure 74. Water channel

Figure 75. Horizontal axis turbine generator

Figure 76. HPP facility, pressurizing pipe

Galuutai-Khunguin hydropower plant of Zavkhan aimag: According to management board resolution number 11th of 2009 of Altai-Uliastai Energy Systems company, Galuutai hydropower plant (it was constructed on Galuutai river of Tsetsen-Uul soum of Zavkhan aimag) is integrated with Khunguin hydropower plant (it was constructed at "Gatsaa" of Khunguin river of Zavkhanmandal soum). They formed "Galuutai-Khunguin Hydropower Plant" LLC.

Figure 77. Galuutai and Khunguin hydropower plant facility

Table 25. Main technical data of Galuutai and Khunguin hydropower plants

Hydropower plants	Galuutai HPP	Khunguin HPP
Installed capacity	150 kilowatt	110 kilowatt
Generator	75 kilowatt synchronization 2 pieces	75 kilowatt and 35 kilowatt
Pressurizing	7.8 m	7 m
Length of dam	12 m	32 m
Water discharge	1.9-2.1 m3/sec	1.9-2.1 m3/sec
Soums and settlements to be provided with electricity	Tsetsen-Uul, Sant-Margats, Songino	Erdenekhairkhan , Zavkhanmandal

3.3. Rain water (snow) harvesting works

The pond is a main facility that collects rain water and snow. It consists of simple and engineering designed facilities; reservoir that collects rain water and snow by blocking mountain valley and gorges; spillway and water filter.

Figure 78. Rain water collecting pond

Rain water and snow is collected in ponds for water supply of livestock and/or irrigation of agriculture or pastureland. The ponds are constructed in areas lacking groundwater resources, such as in high mountain areas, or in areas without permanent surface water, such as the Gobi or steppe region.

In 2008-2010, in total 5 ponds were constructed with a capacity of 190.0 thousand m3. The first phase of "Water National Program" is between 2009 and 2015. Based on aimag and local area requests and preliminary researches of Water Authority, detailed research of not less than 90 ponds will be conducted and they will be constructed on available areas. The second phase is between 2016 and 2021. As a result of researches on construction and use of ponds in Mongolian territory, ponds will be constructed in not less than 130 areas based on local area demand and order.

Table 26. Technical data of old and new ponds

№	Aimag name	Soum name	Pond name	Source	Latitude	Longitude	Pond volume , m^3	Date	Cost, *Thous tug*
1	Bayan-Ulgii	Bugat	Khartolgoi	Snow , rain	49 05 40.8	89 52 16.9	3800	2010	209.0
2	Gobi-Altai	Delger-Biger	Dald Shar Khutul	Snow , rain	46 01 52.1	97 21 36.8	5100	2002 corrected	5200.0
3	Gobi-Altai	Delger	Khurem Baga Khuv	Snow , rain	46 03 01.5	97 10 23.2	2500	2003 corrected	3200.0
4	Gobi-Altai	Delger	Uyert	Snow , rain	46 08 14.2	97 07 39.2	8000	2010	26500.0
5	Gobi-Altai	Tonkhil	Tsagaan Khushuut	Snow , rain	45 58 51.1	93 38 48.1	15000	2007	32700.0
6	Gobi-Altai	Tonkhil	Ugalz river	Snow , rain	46 05 45.4	93 42 59.0	13700	2010	56000.0
7	Govisumber	Sumber	Bayanbulag	Springs	46 32 57.1	108 32 50.4	7200	2010	68400.0
8	Dornogovi	Ikh-Khet	Khalzan Shand	Rain	46 12 56.0	110 19 32.0	400	2003	2000.0
9	Uvurkhangai	Sant	Zaraa Khad	Rain	46 07 04.2	103 47 04.7	1200	2004	5630.0
10	Uvurkhangai	Tugrug	Mogoi river	Rain	45 43 13.2	102 49 45.7	2000	2005	8540.0
11	Uvurkhangai	Bogd	Khovd	Springs	44 40 11.4	102 24 27.8	250	2007	15600.0
12	Tuv	Altanbulag	Shireekhuush	Snow , rain	47 21 24.6	106 17 17.5	1000	2007	18390.0
13	Tuv	Erdene	Bayantsogt Am	Snow , rain	47 30 55.8	107 37 28.2	9472	2009	20900.0
14	Tuv	Khustai NP	Khuurai Am	Snow , rain	47 38 24.7	105 47 31.2	1710	2010	71800.0
15	Khentii	Tsenkher Mandal	Tuluu river	Tsenkher river	47 46 17.05	108 58 25.10	118300	2010	153000.0

Table 27. Ponds to be renovated and newly constructed between 2011 and 2015

№	Aimag name	Soum name	Area name where pond is constructed
1	Arkhangai	Khashaat	Dund Bulag
2	Bayan-Ulgii	Buyant	Bayannuur
3	Bayankhongor	Bumbugur	Bumbatiin Am
4		Zag	Suujiin Bulag
5	Bulgan	Mogod	Zuun Khundii
6	Gobi-Altai	Biger	Daichin Khooloi
7		Delger	Khoit Salaa
8		Jargalan	Shiree Barlag
9		Tsogt	Khuurai Nuur
10	Dornogovi	Ulaanbadrakh	Ulaan Khutul

№	Aimag name	Soum name	Area name where pond is constructed
11	Umnugovi	Khurmen	Shar Sair
12	Zavkhan	Aldarkhaan	Yamaat
13		Tsagaanchuluut	Javtsag
14	Uvurkhangai	Bayan-Undur	Kharzat river
15		Ulziit	Arbulag
16	Umnugovi	Khanbogd	Ikhbulag
17		Khurmen	Shar sair
18		Bayan-Ovoo	Bumbatiin Am
19	Tuv	Bayankhangai	Uran Khundii

Source: Government Implementing Agency, Water Authority, 2010.

4. Sector water consumption and water use

It was reflected in the development method of IWRM plan as follows "base year of the planning is 2008 and deadline of statistics data is January 1, 2011". Based on data and information from relevant ministry, local and regional authorities and water supply companies, 2008 and 2010 water consumption and water use are presented by each aimag, basin and sector in Annex 2 and 3.

4.1. Population drinking water consumption

The population drinking water consumption is divided in three groups: urban population, rural population and municipal services. It is presented by 2008 and 2010.

The urban population includes Ulaanbaatar, other cities and aimag centers; rural population includes soum and bag center population (herders and farmers). As of 2010, there were 21 aimags, 329 soums and 1436 bags. Ulaanbaatar had 9 districts and 132 sub-districts.

According to 2010 population census of NSO, our country's population was 2754.7 thousand. Some 107.1 thousand people are living more than 6 months abroad. Some 2647.5 thousand people are residing in Mongolia permanently. According to the NSO's 2010 "Mongolian Statistics Compilation", which is published annually, some 2780.8 thousand people were living in Mongolia. These two figures are different from one another. More detailed 2008 and 2010 population figures of aimag, capital, soum, district, bag and khoroo from NSO are used in the population drinking water consumption and demand (Table 28).

Table 28. Population number used for population drinking water consumption calculation

№	Aimag name	Population number, *person*					
		2008			2010		
		Total	Urban	Rural	Total	Urban	Rural
1	Arkhangai	89 282	35 559	53 723	90 986	36 327	54 659
2	Bayan-Ulgii	93 931	45 740	48 191	89 191	45 223	43 968
3	Bayankhongor	82 205	36 744	45 461	80 858	37 211	43 647
4	Bulgan	57 874	28 604	29 270	58 369	31 420	26 949
5	Gobi-Altai	55 378	24 463	30 915	56 172	25 315	30 857
6	Govisumber	13 315	10 813	2 502	14 508	12 081	2 427
7	Darkhan-Uul	91 093	86 908	4 185	95 043	90 239	4 804
8	Dornogovi	55 638	37 565	18 073	59 772	45 287	14 485
9	Dornod	74 514	53 082	21 432	74 473	55 592	18 881
10	Dundgovi	47 959	19 393	28 566	45 914	19 873	26 041
11	Zavkhan	76 614	33 458	43 156	71 877	32 030	39 847
12	Uvurkhangai	110 440	53 171	57 269	112 120	55 640	56 480
13	Umnugovi	47 784	25 132	22 652	52 306	30 042	22 264
14	Orkhon	89 875	85 589	4 286	87 869	86 060	1 809
15	Sukhbaatar	53 785	24 540	29 245	54 852	26 105	28 747
16	Selenge	94 590	78 044	16 546	101 752	83 557	18 195
17	Tuv	88 889	50 417	38 472	87 909	42 286	45 623
18	Uvs	77 184	36 634	40 550	74 784	37 457	37 327
19	Khovd	85 897	41 991	43 906	82 204	43 273	38 931
20	Khuvsgul	124 036	62 907	61 129	124 613	64 780	59 833
21	Khentii	67 770	40 550	27 220	70 143	46 086	24 057
22	Ulaanbaatar	1 067 472	1 067 472	-	1 161 785	1 161 785	-
Total		**2 645 525**	**1 978 776**	**666 749**	**2 747 500**	**2 107 669**	**639 831**

Source: NSO, 2010.

Ulaanbaatar city population percentage of total population of Mongolia was 61.8 percent in 2008, 63.3 percent in 2010, an increased by 1.5 percent. It is due to migrants to Ulaanbaatar and it will further increase. Ulaanbaatar city and other cities' population drinking water actual consumption is obtained from USUG and public utility companies.

When compared to the "Population Drinking Water Consumption Temporary norm", approved by the 3rd appendix of 153 order on "Approval of Temporary Norm" of the Minister of Nature and Environment, 1995, the actual daily amount of water used by urban and aimag center apartment residents connected to centralized networks was similar to the norm in 2010.

The actual daily water consumption was lower than the norm for people in soum centers and ger districts which are supplied from kiosks connected to centralized networks and from not centralized water supply (portable kiosks, boreholes/wells, ponds, springs) (Table 29).

Table 29. Daily norm and actual drinking water consumption of one person

Water source types	Water consumption norm, *person.l/day*	Actual water consumption, *person.l/day*	
		2008	2010
Apartments with hot and cold water, connected to centralized water supply networks: Ulaanbaatar, Darkhan, Erdenet, Choibalsan.	230.0	272.3*	237.0*
Apartments with cold water, connected to centralized water supply networks: Aimag and soum centers.	150.0	175	175
Kiosks connected to centralized water supply networks: Ger districts	25.0	8.4	8.8*
Kiosks not connected to centralized water supply networks: Ger districts	25.0	6.4	6.9*
Protected source: kiosk/well, pond, springs	15.0	6.4	6.7
Unprotected source: kiosk/well, pond, springs	15.0	6.0	6.0

Source: *"Population Drinking Water Consumption Temporary Norm" and actual water consumption data from USUG and Housing and Communal Service Authority of Ulaanbaatar city, 2010.*

Remarks: ** Ulaanbaatar city USUG summary report, 2010*

The water supply availability for urban, rural and ger district citizens is different and the population average daily water consumption is significantly different. As of 2010, actual daily water consumption for a person who resides in Ulaanbaatar city apartment block was 237.0 l on average. It is higher compared to other cities of the world (130-160 m^3/day). Apartment residents' water consumption is decreasing due to water meter installation at apartment blocks in recent years and water payment is processed according to water meter indication (Figure 79).

Source: USUG

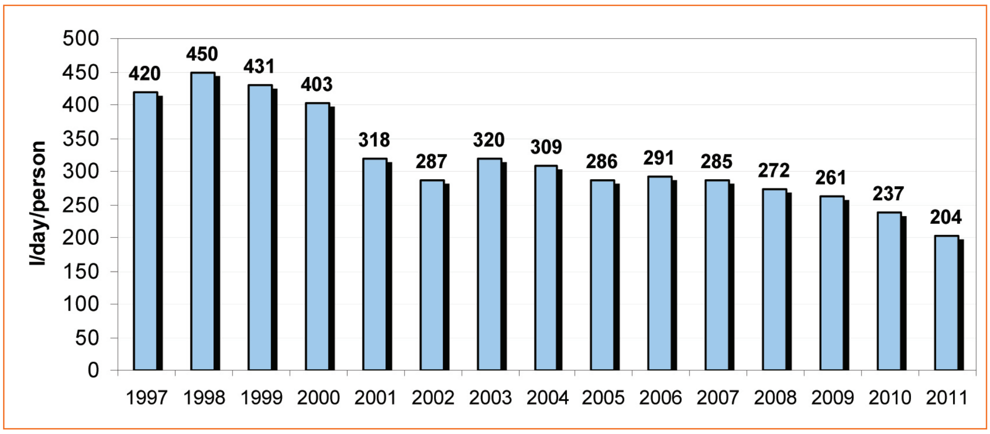

Figure 79. Average actual daily water consumption for apartment residents in Ulaanbaatar

According to the data obtained from Ulaanbaatar city USUG and aimags' public utility companies, 36.0 percent of Mongolia's population or 987.9 thousand people have a connection to a centralized water supply network. The 2008 and 2010 water consumption is presented below (Table 30).

Table 30. Population number and their water consumption that were involved in water supply sources

Water source types		Population, *thous.people*		Water consumption norm, *person.l/day*		Water consumption, *million m³/year*	
		2008	2010	2008	2010	2008	2010
Apartment blocks with hot and cold water, connected to centralized water supply networks	Ulaanbaatar, Darkhan, Erdenet, Choibalsan	480.4	523.9	230.0	230.0	40.4	44.0
	Sukhbaatar city, Zuunkharaa, Bor Undur	13.8	14.7	175.0	175.0	0.9	0.9
Apartment blocks with cold water, connected to centralized water supply networks: Aimag and soum centers		54.2	56.5	175.0	175.0	3.5	3.6
Kiosks connected to centralized water supply networks: Ger districts		317.2	398.3	8.0	10.0	0.9	1.5
Kiosks not connected to centralized water supply networks: Ger districts		609.2	626.4	6.0	8.0	1.3	1.8
Protected sources: kiosks/well, pond, springs		289.8	354.2	6.0	8.0	0.6	1.0
Unprotected sources: Kiosks/well, pond, springs		551.4	567.7	6.0	8.0	1.2	1.7
Other sources		329.5	205.8	6.0	8.0	0.7	0.6
Total		2 645.5	2 747.5			49.5	55.1

Note: *Water consumption norm is amended on the basis of actual water consumption*

The urban and rural population drinking water consumption is very different from one another. As of 2010, urban residents on average used 67.6 liter water daily, rural residents on average used 12.0 liter water daily. Most of drinking water consumption is in Ulaanbaatar, Darkhan and Erdenet.

Table 31. Urban and rural population drinking water consumption

Indicator	2008			2010		
	Urban	Rural	Total	Urban	Rural	Total
Population, *person*	1 978 776	666 749	**2 645 525**	2 107 669	639 831	**2 747 500**
Annual water consumption of one person, l/year	23 702	3 900	18 711	24 624	5 001	20 055
Daily water consumption of one person, l/day	64.9	10.7	51.3	67.5	13.7	54.9
Total water consumption, *million m³/year*	46.9	2.6	49.5	51.9	3.2	55.1

The 2008 and 2010 urban and rural population total drinking water consumption is presented in Table 51 of Annex 2, Table 58 of Annex 3, as it was calculated by aimag and river basin using the norms of Table 30 and the water supply coverage of Table 4.

Data on public services (schools, hospitals, administrative offices) and commercial services (hotels, restaurants, saunas, etc) drinking water use is based on actual water use data, obtained from relevant aimag and Ulaanbaatar organizations. The data on public and commercial services water use is collected until 2010. The 2010 water use is increased by 5 percent compared to that of 2008 (Table 32).

The 2008 and 2010 total public and commercial services water use is calculated by each aimag, basin and Ulaanbaatar. It is in Table 52 of Annex 2 and Table 59 of Annex 3.

Table 32. Water consumption of public services and service organizations

Public services and commercial services	2008			2010		
	Public services	Commercial services	Total	Public services	Commercial services	Total
Total water use, *million m³/year*	5.3	3.7	**9.0**	5.5	3.9	**9.4**

4.2. Industrial water use

The industrial water use is categorized into 5 groups including light and food industry; heavy industry; energy; mining; construction and construction material production. Data on industries' actual water use is not that available. It is possible to calculate water use by manufactured products of the industries. But it is difficult to conduct detailed calculation due to industrial and products' types.

So when calculating industrial water use, it would be appropriate to adhere to the "Temporary Water Norm for Unit Product Production" approved by the 1st annex of 153rd order of 1995 of the Minister of Nature and Environment.

The total 2008 and 2010 industrial water use is calculated by each aimag, basin and Ulaanbaatar city. It is presented in Table 53 and Table 54 of Annex 2 and Table 60 and Table 61 of Annex 3.

4.2.1. Light and food industry

Light and food industry water use is calculated on the basis of water norm used for producing unit product and manufactured products' amount and norm. Data on actual light and food industry water use is scarce. This group includes industries that process food, beverage, wool, cashmere and skins. A garbage/waste reprocessing industry is being constructed at Ulaan Chuluut dump near Ulaanbaatar. It has benefits to decrease waste-related water pollution. This facility's annual water use is estimated at 0.8 million m^3.

4.2.2. Heavy industry

When calculating heavy industry water use outside Ulaanbaatar city, it is based on manufactured products' amount and water use norm. Data on actual water use is not completely obtained. Data on actual water use and manufactured products is rare/ scarce. The annual water use of the industries located in Ulaanbaatar territory is estimated at 0.25-0.3 million m^3.

4.2.3. Energy and heat

The actual water use is summarized for heat and energy production by the main thermal power plants. The water use of small energy producers is calculated on the basis of produced energy and water use norms.

Table 33. 2008 actual water use of thermal power plants

Plant name	Current capacity		Water use, *million m³/year*	Number of boreholes
	Electricity/energy, *megawatt/hour*	Heat, *Gkal/hour*		
Ulaanbaatar TPP-II	21.5	93.5	2.0	2
Ulaanbaatar TPP-III	136.0	570.0	9.4	13
Ulaanbaatar TPP-IV	560.0	1 185.0	10.7	14
Darkhan TPP	48.0	290.0	3.9	9
Erdenet TPP	28.8	193.5	1.2	14
Dornod TPP	36.0	150.0	2.9	2
Dalanzadgad TPP	5.4	2.0	0.8	3
Total	**837.3**	**2 484.0**	**30.9**	**57**

It is required to consider hydropower plants water use separately. Much water is used for hydropower plants. But there is not much change in water volume and quality. Water is used to generate energy by turbines and it is possible to reuse the water at the downstream side that has flowed through the turbines from the reservoir.

Therefore hydropower plant water use is not included in the total industrial water use calculation. Actual data on water used for hydropower plants is unclear. It is possible to calculate hydropower plant water use on the basis of energy amount produced by hydropower plants or hydropower plant capacity.

The 2010 hydropower plant water use is 6 times higher than that of 2008 due to Taishir and Durgun hydropower plants' start-up (Table 34).

Table 34. Hydropower plant water use

Hydropower plant water use	2008	2010
Total water use, *million m³/year*	~ 170	~ 1000

4.2.4. Mining

Mining water use was calculated on the basis of data on actual mining water use obtained from the Water Authority. It is assumed that most companies reuse some 70 percent of the water, obtained from water source as mining purpose. Mining water use occupies most of the industrial water use. Each mine's water use is different due to mining technologies. As for gold mine, it reuses some 30 percent of the water using.

Data collection on mining water use started since 2008. But data is not completely obtained. As for some coal mines, water are piped out of mines and it should be counted as mining water use. But data is very scarce.

4.2.5. Construction, construction material production

Water use is calculated on the basis of manufactured products and water norms for manufacturing a unit product. Data to estimate total current amount of actual water use has not been obtained.

4.2.6. Total industrial water use

The 2008 and 2009 economic recession and the new law on natural resources impacted the industries water use. The 2010 total water use decreased compared to that of 2008 (Table 35).

Table 35. Total industrial water use

Industrial sector	Water use, *million m³/year*	
	2008	2010
Light industry: knitting, wool and cashmere, skins etc	0.4	0.4
Food industry: food and beverage production etc	1.9	3.2
Heavy industry	1.3	1.3
Construction, construction material	1.0	1.2
Energy and heat	35.2	33.4
Mining	49.4	41.5
Total water use, *million m³/year*	**89.2**	**81.0**

4.3. Agricultural water consumption and water use

Agricultural water use consists of livestock water consumption and irrigation water use.

4.3.1. Livestock

The 2008 and 2010 livestock water consumption is estimated on the basis of livestock number and water consumption norm. According the "Temporary Norm of Livestock Water Consumption" which was approved by 4th annex of 153rd order of 1995 of the Minister of Nature and Environment, the norm is different depending on livestock type, age and seasons.

In this calculation, an average norm is applied. The 2010 livestock water consumption decreased compared to that of 2008 due to the loss of about 10 million livestock which died during the 2009 and 2010 dzud (Table 36).

Table 36. Livestock water consumption

Indicator		Total	Sheep	Goat	Cow	Horse	Camel
Water consumption average norm, l/day			3.5	3.5	23.0	24.0	57.0
2008	Livestock number, *thous.*	**43 288.4**	18 362.3	19 969.4	2 503.4	2 186.9	266.4
	Total water consumption *million m³/year*	**94.7**	23.5	25.5	21.0	19.2	5.5
2010	Livestock number, *thous.*	**32 729.5**	14 480.4	13 883.2	2 176.0	1 920.3	269.6
	Total water consumption *million m³/year*	**76.9**	18.5	17.7	18.3	16.8	5.6

Remarks: In total water consumption of livestock, intensified (farming) water demand is included.

As of 2010, there were 25000 pigs and 425000 chickens in Mongolia. The pig and chicken farming water consumption (0.2 million. m³/year) is included in the calculation. But it is very small compared to the total livestock water consumption.

The 2008 and 2010 total livestock water consumption is calculated by each aimag, basin and Ulaanbaatar city. It is presented in Table 55 and Table 56 of Annex 2 and Table 62 of Annex 3.

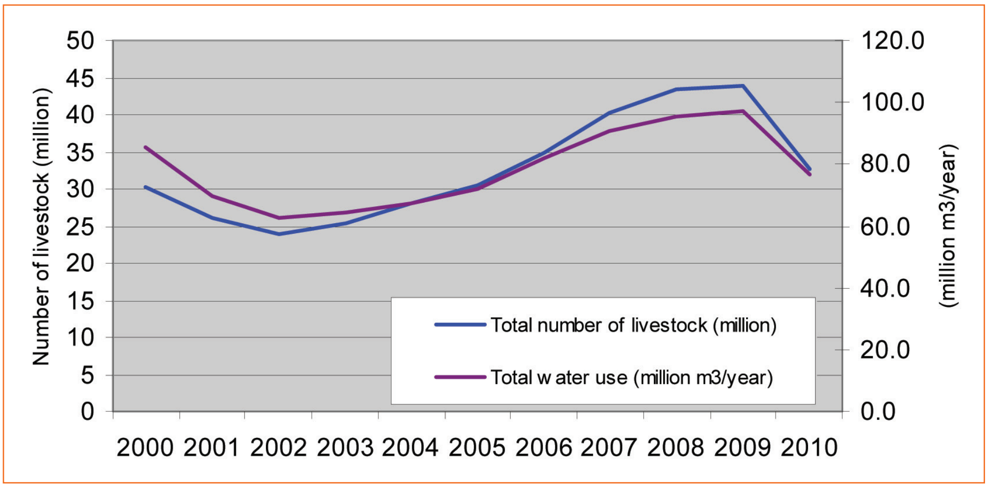

Figure 80. Total livestock water consumption

4.3.2. Irrigation

The crop water use was calculated on the basis of irrigation data obtained from MFALI and aimags as well as "Irrigation Norm", approved by the 5th annex of 153rd order on "Temporary Norm Approval" of 1995 of the Minister of Nature and Environment (Table 37).

Table 37. Irrigation norm, established by crop areas and sown types

Crop name	Irrigation norm for 1 ha, m^3/ha				
	Altai / Khangai	Central region	East region	Northern Gobi region	Southern Gobi region
Corn	1800-2000	2000-2400	2500-2800	2600-3000	4100-4400
Grain	1800-2000	2600-2900	2800-3100	2900-3200	3200-3600
Fodder plant (1 year old or annual plants)	1500-1800	1800-2800	2400-2800	2600-3000	3200-3600
Potatoes	2000-2400	2500-3000	3100-3400	3200-3600	4000-4500
Vegetables	2200-2500	2600-3200	3500-3900	3600-4000	-
Fodder plant (2 year old and perennial plants)	2400-2900	3000-3300	3500-4000	3600-4100	3800-4200

Data on actual irrigation area is different from one another. According to the MFALI data, 30017 ha irrigated area was planted in 2008 and 37567 ha irrigated area was planted in 2010. The water amount used for irrigation changes each year due to the precipitation amount. Measurement of water used for irrigation is not conducted. Due to these factors, it is hard to estimate the actual crop water use.

The 1989-2010 irrigated areas and crop water use is presented in Figure 81.

The farming sector faced a downfall since 1990's and there was no irrigation. Since 2003, the State gave financial support for irrigation entities and people to rehabilitate irrigation systems and construct new ones. By doing so, the irrigation area increased. The irrigation area was 37567 ha in 2010 an increase by some 20 percent compared to 2008. Also, the water volume used for the crop irrigation increased: 83.5 million m^3 in 2008 and 98.7 million m^3 in 2010.

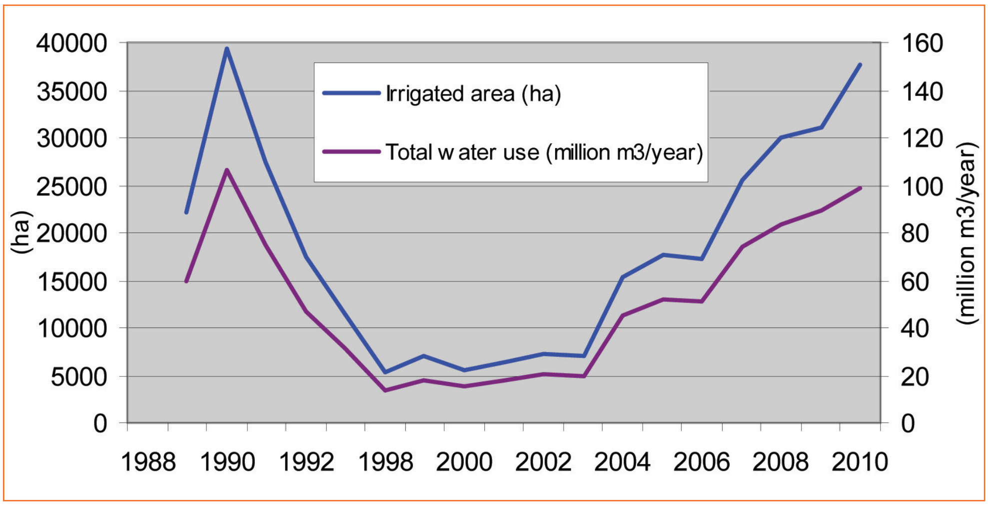

Figure 81. Total irrigated area and crop water use

The 2008 and 2010 total agricultural sector water consumption and water use are presented in Table 38.

Table 38. Total water consumption and water use of agricultural sector

Agricultural sector	Water consumption and water use	
	2008	2010
Livestock water consumption	94.7	76.9
Irrigation water use	83.5	98.7
Total water consumption and water use, *million m³/year*	**178.2**	**175.6**

The 2008 and 2010 irrigation crop water use is estimated by each aimag, basin and Ulaanbaatar city. It was based on irrigation area, crop regions and irrigation norm established for the sown types. It is presented in Table 57 of Annex 2 and Table 63 of Annex 3.

4.4. Tourism and green areas water consumption

4.4.1. Tourism

Most of the tourists come to Mongolia in the summertime. Their average staying time is 2 weeks. The 2008 and 2010 tourism water use is calculated as if one tourist stays in an urban hotel, he/she uses 230 l water per day (same as apartment block population water consumption), if one stays in rural tourist camp, he/she uses 25 l water per day (Table 39).

Table 39. 2008 and 2010 tourism water consumption

Indicator	2008	2010	Remarks
Annual tourist number, *person*	446 400	456 300	Source: NSO statistics compilation
Average staying time in Mongolia	14 days		Estimate
Average staying time in hotel and tourist camps	50 percent of the trip		Estimate
Average water use tourist in urban hotel	230 l/day		Same as apartment resident daily water consumption
Average water use tourist in tourist camp	25 l/day		Same as daily water consumption supplied by kiosk
Total water use, *million m³/year*	**0.6**	**0.8**	

4.4.2. Green areas and "Green Wall" program

The following works are being conducted in urban areas including establishing parks; planting lawn along the road and squares; planting trees. According to Ulaanbaatar city Statistics Office data, 7139.3 thousand m^2 area was gardened/planted with trees in 2010 in Ulaanbaatar city.

Some 3625.9 thousand m^2 area was planted with lawn and 2828.1 thousand pieces of trees were planted. Much water is used for establishing big parks in Darkhan and Erdenet; planting trees and lawn. The actual data on water use is scarce. Green area irrigation is conducted between beginning of April and beginning of August.

It is estimated that 0.15 million m^3 water is used annually for the green area irrigation of Ulaanbaatar, Darkhan, Erdenet and other aimag centers. According to data from the Forest Authority, a Government Implementing Agency, 471 ha forest was planted in 2008, 106 ha forest strip was planted in 2010. But data on water used does not exist.

Water used within the framework of 2008 and 2010 urban green areas and "Green Wall" program has been calculated based on data obtained from relevant aimag and Ulaanbaatar organizations; "Water Use Normative for Tree Plantation" and "Temporary Lawn irrigation Normative" approved by annex 6 and 7 of 153th order on "Temporary Norm Approval" of 1995 of the Minister of Nature and Environment (Table 40).

Table 40. Water consumption of urban green areas and "Green Wall" program

Indicator	Water consumption, *million m^3/year*		Remarks
	2008	2010	
Urban green areas	0.15	0.15	
"Green Wall" national program	0.3	0.2	2005 and 2006, 0.27 million m^3

The "Green Wall" program implementation has been slow in recent years and water use was likely decreased.

4.5. Consolidated result of water consumption and water use

Based on the above mentioned calculations, the 2008 and 2010 total nationwide water consumption and water use is calculated for each sector (Table 41).

Table 41. Consolidated result of water consumption and water use

Water consumer and user sectors		Water consumption and water use, *million m^3/year*	
		2008	2010
Population drinking water	Urban	46.9	51.9
	Rural	2.6	3.2
Public services and commercial services	Commercial services	3.7	3.9
	Public services	5.3	5.5
Industry, construction, construction material production	Light and food industry	2.2	3.6
	Heavy industry	1.3	1.3
	Energy	35.2	33.4
	Mining	49.4	41.5
	Construction industry	1.0	1.2
Agriculture	Livestock	94.7	76.9
	Irrigation	83.5	98.7

Water consumer and user sectors		Water consumption and water use, *million m^3/year*	
		2008	2010
Other	Tourism	0.6	0.8
	Green areas	0.3	2.5
	Roads, railways, transport	2.3	2.7
Total water consumption and water use		**329.0**	**327.1**
Hydropower plant		*~ 170*	*~ 1000*

4.6. Recommendations on water consumption and water use

- Much water is used by hydropower plants but except for reservoir surface water evaporation, there is no water loss. Therefore hydropower plant water use is not included in total water use. But professional water organizations should conduct monitoring on hydropower plant water use.
- Data on water used for industries (light, food and heavy industries; mining; construction and construction materials) is scarce. In the future, study needs to be carried out in this field.
- By installing water meters at apartment blocks and organizations, the daily water consumption per person is decreasing. Therefore the water consumption norm needs to be renewed.
- When comparing the 2008 and 2010 water consumption and water use, drinking water consumption was increased by 13 percent, agricultural water consumption and water use was decreased by 1.5 percent, industrial water consumption and water use was decreased by 12 percent and total water consumption and water use was decreased by 3 percent. The decrease of the water consumption and water use is connected to the 2009 economical recession and the 2009 and 2010 dzud livestock losses.
- In order to save water resources, industrial water needs to be reused and domestic waste water needs to be completely treated and delivered to nature. Detailed research on reuse of treated waste water should be carried out.

5. Water demand

The future trend of the water consumption and water use or the future water demand is calculated using high, medium and low scenarios based on water users and consumers' growth and water demand norm. The water demand is calculated for the years 2015 and 2021 in accordance with the implementation period of the "Water National Program", "Millennium Development Goal based Comprehensive National Development Policy" which was approved by the Government and Parliament and other relevant policies.

The sectors' growth percentage prediction, from 2010 to 2021, is presented in Table 48.

5.1. Population drinking water demand

5.1.1. Population drinking water

The future population drinking water demand depends on the urban and rural population growth, the water supply coverage and the changes in the water demand norm.

- When calculating population growth, the "Mongolian Population Projection for 2010 and 2040" was used. It was conducted in 2010 by NSO. In this calculation, population growth is estimated by three scenarios including low, medium and high.

Current water demand norm has been amended by considering that drinking water demand norm will be changed due to international standard norm and one person's daily water demand amount change (Table 42).

Water supply coverage is based on projections made by MRTCUD.

Table 42. Drinking water demand norm and water demand by medium scenario.

Water source types		Population, *Thousand people*		Water demand norm, *l/day*		Water demand, *million m³/year*	
		2015	2021	2015	2021	2015	2021
Apartment blocks with hot water, connected to centralized water supply systems	Ulaanbaatar, Darkhan, Erdenet, Choibalsan	777.0	939.3	200	160	56.7	54.8
	Sukhbaatar city, Zuunkharaa, Bor Undur	18.8	21.7	170	160	1.2	1.3
Apartment blocks with cold water, connected to centralized water supply systems: Aimag and soum centers		91.5	114.0	170	160	5.7	6.6
Kiosks connected to networks		509.7	601.3	25	30	4.7	6.6
Kiosks not connected to networks		514.0	586.4	15	20	2.8	4.3
Protected sources: wells, ponds, springs		421.8	505.9	10	15	1.5	2.8
Unprotected sources: wells, ponds, springs		642.4	456.5	10	15	2.3	2.5
Total		**2 975.2**	**3 225.2**			**74.9**	**78.9**

The three scenarios developed for drinking water are:

- **Low scenario:** The population growth is assumed to be the same as the lowest scenario used by NSO. The number of connections is assumed to be 5% lower than the medium scenario. The water consumption norms are the same as the medium scenario.
- **Medium scenario:** The population growth and the projection of the water supply coverage are equal to the growth rates used by the NSO and the

MRTCUD. The percentage of urban population reaches 69.6% in 2021.The water use norms of apartments decrease and of kiosks and protected sources increase.

- **High scenario:** The total population growth is assumed to be the same as the highest scenario used by NSO. The percentage of urban population reaches 70.3% in 2021. The number of connections is assumed to be 10% higher than the medium scenario. The water consumption norms are the same as the medium scenario.

The total water demand in 2021 is only slightly higher than the total demand in 2015 due to the reduction in water use norms for apartments in the cities (Table 43 and Figure 82). This highlights the importance of more efficient water use in apartments to reduce the total water use in cities.

Table 43. Projected water demand drinking water

Scenario		2015			2021		
		Low	Medium	High	Low	Medium	*High*
Population *(thousand)*	Urban	1,975.9	2,017.4	2,058.9	2,149.7	2,237.8	2,326.8
	Rural	967.4	957.8	948.3	979.5	987.4	994.3
	Total	2,943.3	2,975.2	3,007.2	3,129.2	3,225.2	3,321.1
Total water demand, *million m³/year*	Urban	66.3	70.9	78.6	67.2	72.9	81.8
	Rural	4.1	4.0	4.0	5.9	6.0	6.0
	Total	70.4	74.9	82.6	73.1	78.9	**87.8**

The total population drinking water demand by aimag and by river basin is presented in Annex 4, Table 64 and Annex 5, Table 74.

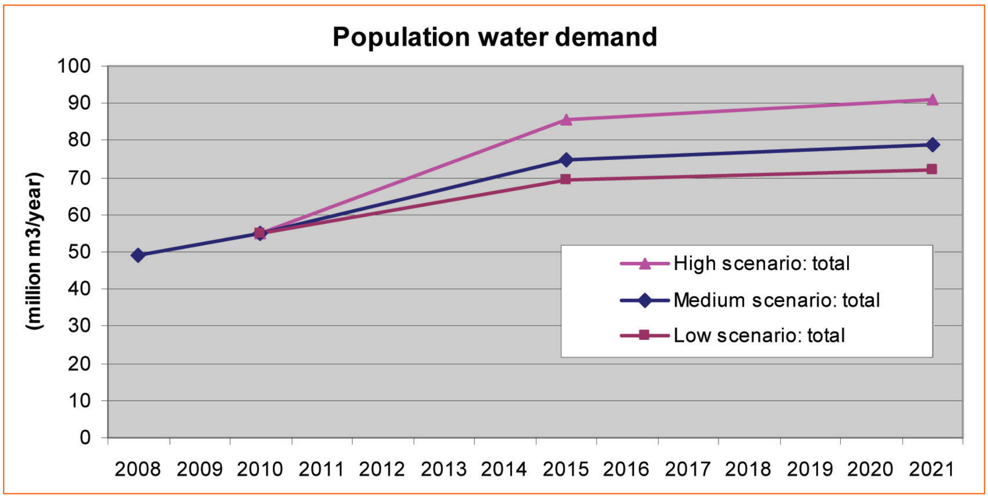

Figure 82. Projected water demand drinking water

5.1.2. Public services and commercial services water demand

The drinking water demand in 2015 and 2021 of public services and commercial services is projected using for public services growth rates equal to the population growth rate and for services growth rates equal to the economical growth rate (GDP).

Table 44. Projected public services and commercial services drinking water demand

Public services and commercial services	Water demand, *million m³/year*					
	2015			2021		
Scenario	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*
Public services	5.7	5.9	6.8	6.0	6.5	8.5
Commercial services	4.8	5.6	7.6	6.3	8.7	17.2
Total	**10.5**	**11.5**	**14.4**	**12.3**	**15.2**	**25.7**

The public services and service organizations water demand is presented by aimag in Annex 4, Table 65 and by river basin in Annex 5, Table 75.

5.2. Water demand industries

The future demand for industrial water use depends on the growth of the industrial activities and the applied industrial water use norms. The projection is based on the industrial growth rates until 2015 as specified in the regional development programs. The trend is extended until 2021 using the targets specified in the MDG. The same water use norms are used for each scenario:

Low scenario: The growth of the industrial water use is assumed to be a continuation of the observed trend.

Medium scenario: The growth of the industrial water use is equal to the growth specified in the regional development programs.

High scenario: The growth of the industrial water use is based on the trends described in the MDG comprehensive policy documents.

Water savings due to new technologies are not considered. Also decreases in water use due to the introduction of fees for pollution are not considered.

In 2015 it is expected that three new major power plants will be in operation. These are power plants in Ulaanbaatar (nr. 5), Ukhaa Hudag in Omnogovi aimag and Murun in Khovsgol aimag. Power plant nr. 5 in Ulaanbaatar is expected to be expanded after 2015. The water demand of these plants is included in the total water demand estimate.

The waste recycling plant planned at Ulaanbaatar is estimated to have a water demand of 0.8 million m³/year. This volume is included in the total estimate of the energy sector.

The period until 2021 will include the start of some major mines. The expected water demand of these mines is presented in Table 45. This volume is included in the total water demand estimate of the medium scenario. The water demand of these mines is estimated at 20% higher for the high scenario and 50% lower for the low scenario.

Table 45. Water demand estimate of some major mines until 2021

№	Name of mine	Aimag	River Basin	Water demand *(million m3/year)*	
				2015	2021
1	Asgat	Bayan Ulgii	Khovd	0.5	0.5
2	Tsagaan Suvarga	Dornogobi	Galba-Uush	7	9.4
3	Mardai	Dornod	Ulz	2.1	2.1
4	Tsav	Dornod	Ulz?	0.44	0.44
5	Ulaan	Dornod	Ulz	7	9.6
6	Tamsag	Dornod	Ulz	1.2	1.4
7	Oyu Tolgoi	Umnugobi	Galba-Uush	9.5	12.9
8	Tavan Tolgoi	Umnugobi	Galba-Uush	5.2	14.5
9	Nariin Sukhait	Umnugobi	Altain Uvur Gobi	1.7	3.4

№	Name of mine	Aimag	River Basin	Water demand *(million m3/year)*	
				2015	2021
10	Olon Ovoot	Umnugobi	Ongi	0.9	0.9
11	Boroo	Selenge	Kharaa	2	3
12	Tumurtein	Selenge	Eroo	0.1	0.1
13	Altai Dornod Mongol	Tuv	Tuul	1.5	1
14	Monpolimet	Tuv	Tuul	1.5	1
15	Shijir Alt	Tuv	Tuul	2.5	1.5
16	Burenkhaan	Khuvsgul	Delgermurun		
17	Baganuur	Ulaanbaatar	Kherlen	5	5
18	Erdenet	Orkhon	Selenge	15	15
19	Shivee Ovoo	Gobisumber	Umard Goviin	2.4	2.4
20	Choir, Nyalga	Gobisumber	Umard Goviin	0.5	0.5
			Total	**66.04**	**84.64**

Sources: *Water Authority, Mineral Resources Authority, Technical requirements of Oyu Tolgoi, Tsagaan Suvarga, Tavan Tolgoi, Choir Nyalga, Tsagaan Tsav.*

The total industrial, construction and construction material water demand is presented in Table 46. It is calculated in the level of 2015 and 2021 by 3 scenarios.

Table 46. Projected water demand of industries

Industrial water demand	Total water demand 2015 *(million m³/year)*			Total water demand 2021 *(million m³/year)*		
Scenario	Low	Medium	High	Low	Medium	*High*
Manufacturing: textile, wool, etc	0.5	0.6	0.7	0.6	0.8	1.5
Manufacturing: food, beverages	3.9	4.5	5.9	5.0	6.8	12.0
Heavy industries	1.6	1.8	2.3	2.0	2.7	4.7
Constructions	1.6	2.0	2.4	2.1	3.2	4.5
Energy	37.8	44.7	54.3	43.9	63.5	97.3
Mining	51.9	81.1	102.0	61.1	111.1	186.1
Total	97.3	134.7	167.6	114.7	188.1	**306.1**

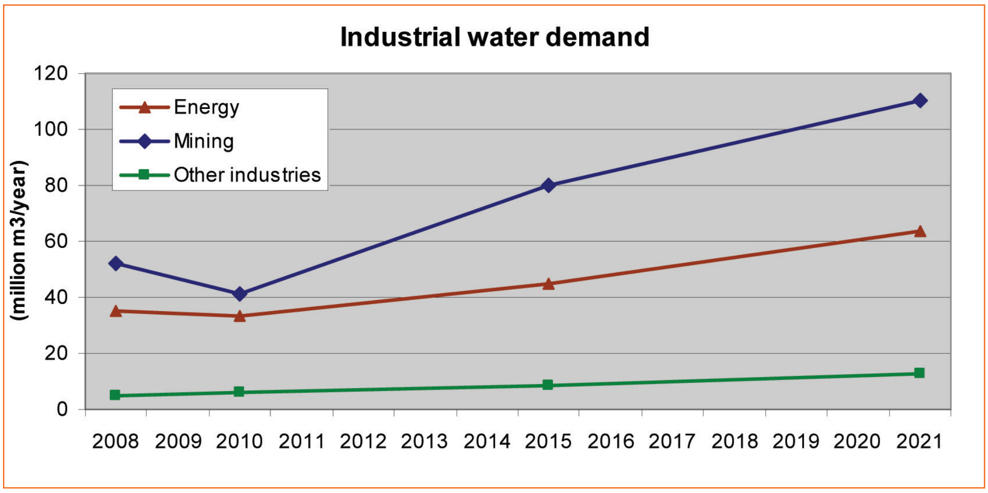

Figure 83. Projected water demand industries for medium scenario

The total industrial water demand is calculated by each aimag, basin and Ulaanbaatar city. It is presented in Table 71 of Annex 4 and Table 78 of Annex 5.

5.3. Water demand agriculture

The future water demand for agricultural water use depends on the growth of the livestock numbers and irrigated areas.

Livestock water demand: The livestock numbers have declined in 2010 but are expected to rise until 2015. In the period until 2021 the government is expecting that policies to reduce the number of livestock are successful and the projected total number in 2021 is lower than in 2015. Livestock water demand norm will be the same in all scenarios (Table 36).

Low scenario: the projection used in the medium scenario is reduced by 5%;

Medium scenario: MFALI assumes a reduced growth in animals by supposing that measures are successful to protect the grazing potential of the pasture; the number of animals is expected to reach 35.6 million in 2021;

High scenario: Davaadorj G. (2009) analysed the potential increase in livestock numbers based on construction of new water supply wells and an increase in fodder production; his estimate is considerably higher than the numbers projected by MFALI: 52.6 million animals in 2021.

Water demand is changing due to change of livestock types and numbers.

Irrigation water demand: The projection of the irrigation area is based on estimates provided from different sources. All sources assume sufficient financial resources for investments in irrigation but the availability of these sources is not guaranteed. Therefore the projections seem optimistic. Nevertheless the projection used by MFALI is used as medium scenario.

Low scenario: The government started investments in irrigation since 2003. The area irrigated increased significantly in 2004 and after 2007; continuing a linear trend from 2003-2010 the irrigated area is projected to reach 63,000 ha in 2021;

Medium scenario: MFALI is planning an increase in irrigated area to reach 80,000 ha in 2018 and 100,000 ha in 2023; in this scenario it is assumed that an area of 60,000 ha will be reached in 2015 and 92,000 ha in 2021;

High scenario: Davaadorj G. (2009) has analysed existing policy documents and provides an overview of planned increases in irrigated areas; the total area is large and therefore considered optimistic; Davaadorj G. projects the irrigated area to reach 137,000 ha in 2021.

The 2015 and 2021 total agricultural water demand is presented in Table 47 and it is calculated by 3 scenarios. Water demand and water use since 2008 and agricultural water demand until 2021 are calculated and presented in Figure 84.

Table 47. Projected water demand of agriculture

Agriculture	2015			2021		
Scenario	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*
Livestock numbers (million)	34.3	36.1	49.0	33.8	35.6	52.6
Irrigated area (ha)	47,600	60,000	77,350	63,000	92,000	137,000
Water demand	**Total 2015** *(million m3/year)*			**Total 2021** *(million m3/year)*		
Livestock	90.2	94.9	109.4	103.1	108.6	117.3
Crop irrigation	125.0	157.6	203.2	165.5	241.7	360.0

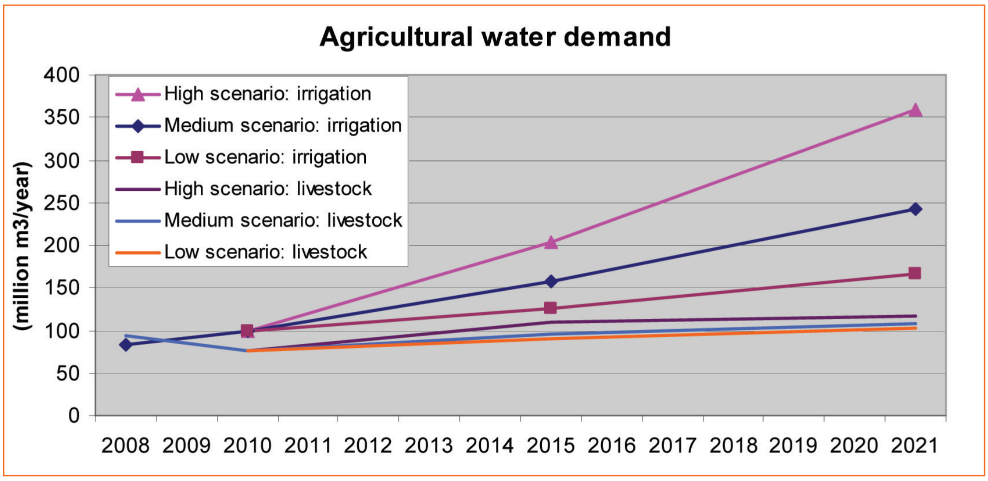

Figure 84. Projected water demand agriculture

The water demand by irrigation is directly related to the area irrigated and the significant difference in area between the scenarios may be seen clearly in the projected water demand. In the case of livestock the small difference in water demand between the scenarios can be explained by the fact that the difference in livestock numbers is mainly caused by the number of sheep and goats which use a small quantity of water per animal and less by the bigger animals which use more water per animal.

The 2015 and 2021 agricultural water demand is calculated by each aimag, basin and Ulaanbaatar city. It is presented in Table 72 and Table 73 of Annex 4 and Table 79 of Annex 5.

5.4. Water demand by tourism and green areas

The water demand for tourism is related to the increase in the number of tourists visiting Mongolia. According the national policy it is expected that the number of tourists will double to 1 million visitors by 2015 and increase to 2.5 million by 2015. The water demand is assumed to increase proportionally to 1.8 million m^3/year in 2015 and to 4.5 million m^3/year in 2021. The growth of the tourism water demand in the low and high scenario's is assumed to be 20% lower and 20% higher respectively.

The water demand for watering green areas in the cities is not clear. The service has been erratic in the past years and it is therefore difficult to project. Assuming an increase in watering the water demand is estimated to double to 0.3 million m^3/year in 2015 and quadruple to 0.6 million m^3/year in 2021. The growth of the green area water demand in the low and high scenario's is assumed to be 20% lower and 20% higher respectively.

The water demand for the green belt program is not clear and therefore not included.

The new sea-buckthorn program will require water, but the area irrigated is not expected to grow fast. It is assumed that the water demand of this area is included in the total irrigation water demand.

5.5. Water demand summary

A summary of the applied growth rates and other assumptions is presented in Table 48.

Table 48. Overview of applied scenarios with annual growth rates

Water use sectors	Low scenario	Medium scenario	High scenario
Drinking water use			
Population growth	2010-2015: 1.32% 2015-2021: 1.03%	2010-2015: 1.54% 2015-2021: 1.35%	2010-2015: 1.76% 2015-2021: 1.67%
% urban population in 2021	68.9 %	69.6 %	70.3 %
Private connections and connected kiosks	2015: 44.0% 2021: 48.7%	2015: 46.7% 2021: 51.8%	2015: 51.6% 2021: 57.2%
Consumption norm (see Table 42)	Change of norm similar as medium scenario	Norm lower for connections and higher for not connected water users	Change of norm similar as medium scenario
Municipal water use			
Public services	0.7% growth	1.4% growth	4% growth
Commercial services	4.5% growth	7.6% growth	14.5% growth
Industrial water use			
Manufacturing	4% growth	6.9% growth	12.6% growth
Heavy industries	4% growth	6.9% growth	12.6% growth
Construction	4% growth	6.9% growth	10% growth
Mines – existing Mines – new	3% growth 50% lower than MME estimates	10.5% growth According MME estimates	23% growth 20% higher than MME estimates
Energy	2.5% growth	6% growth	10.2% growth
Livestock water use			
Livestock numbers	5% lower than medium scenario	Projection according MFALI	Projection according Davaadorj G. (2011)
Consumption norm	Norm unchanged	Norm unchanged	Norm unchanged
Irrigation water use			
Irrigated area *	According trend 1998-2010, 63,000 ha in 2021: 2010-2015: 4.8% 2015-2021: 4.8%	Projection according MFALI, 92,000 ha in 2021: 2010-2015: 9.8% 2015-2021: 7.4%	Projection according Davaadorj G. (2011) , 137,000 ha in 2021: 2010-2015: 15.5 % 2015-2021: 10%
Crop water requirement	Unchanged	Unchanged	Unchanged
Tourism water use			
Water demand growth	20% lower than medium scenario	2010-2015: 14.9% 2015-2021: 16.5%	20% higher than medium scenario
Green areas water use			
Water use	20% lower than medium scenario	2010-2015: 8% 2015-2021: 12%	20% higher than medium scenario

* *planning of cultivated area by aimag for the years 2015 and 2021; due to shift in crops with higher water requirement annual increase in water demand is 11.45%*

The total sector water demand calculated by 3 scenarios for the years 2015 and 2021 is presented in Table 49 and Figure 85.

Table 49. Water demand summary

Sectors that use water		Total water demand 2015 (million m^3/year)			Total water demand 2021 (million m^3/year)		
Scenario		low	medium	high	low	medium	*high*
Drinking water supply	Urban	66.4	70.9	78.6	67.2	72.9	81.8
	Rural	4.1	4.0	4.0	5.9	6.0	6.0
Municipal water supply	Commercial services	4.8	5.6	7.6	6.3	8.7	17.2
	Public services	5.7	5.9	6.8	6.0	6.5	8.5
Industrial water supply	Light and food	4.4	5.1	6.6	5.6	7.6	13.5
	Heavy industries	1.6	1.8	2.3	2.0	2.7	4.7
	Constructions	1.6	2.0	2.4	2.1	3.2	4.5
	Energy	37.8	44.7	54.3	43.9	63.5	97.3
	Mining	51.9	81.1	102.0	61.1	111.1	186.1
Agricultural water supply	Livestock	90.2	94.9	109.4	103.1	108.6	117.3
	Crop irrigation	125.0	169.8	203.2	165.5	260.8	360.0
Others	Tourism	1.2	1.4	1.6	2.7	3.4	4.0
	Green areas	2.5	2.6	2.6	2.7	2.9	3.0
	Roads and transport	3.2	3.6	4.1	4.1	4.5	5.0
Total:		400.6	493.4	585.6	478.2	662.4	908.9

The increase of the total water demand according the three scenarios shows that the low scenario indicates the lowest trend in the years until 2021. The medium scenario indicates a more progressive trend resulting in a 37% higher water demand in 2021, while the high scenario requires about two times as much water than the low scenario in 2021.

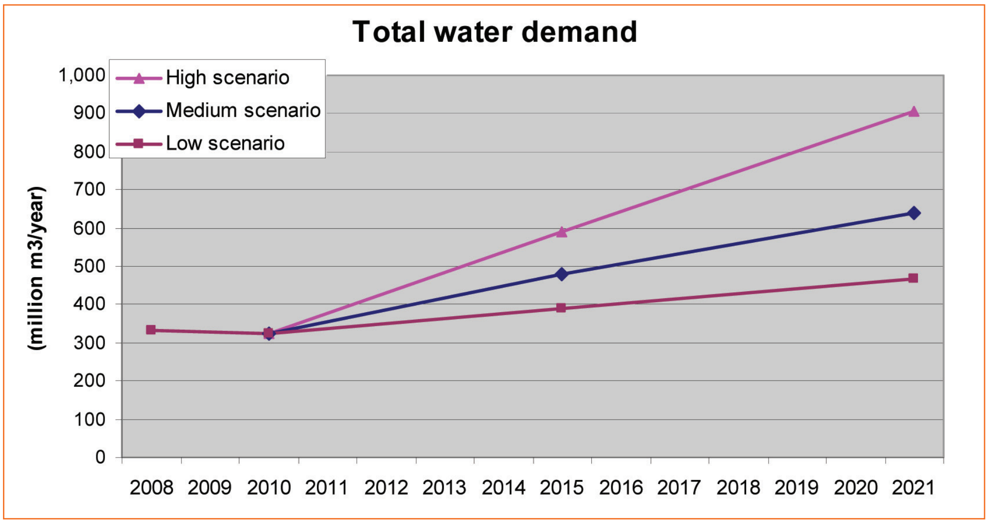

Figure 85. Projected total water demand

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9. Aimags' websites and development program

Annex

Annex 1. Basic information

Table 50. Urban drinking water supply infrastructure

Aimag	City	Total number of wells	Working wells	Number of pumping stations	Number of reservoirs	Volume of reservoirs *(m³)*	Length supply pipeline *(km)*	Number of kiosks
Population > 100,000								
Ulaanbaatar	Ulaanbaatar	176	?	4	11	3,000(8) 6,000(3)	348.6	468
Population 50,000 – 100,000								
Orkhon	Erdenet	14	?	4	10	10,000(6) 1,000(2)	180	42
Darkhan-Uul	Darkhan	18	10	2	4	2,000(2) 6,000(2)	215.3	40
Population 30,000 – 50,000								
Dornod	Choibalsan	8		1	2	2,000	39.3	23
Khovsgol	Moron	4+10	1	1	2	150	5.2	21
Population 20,000 – 30,000								
Khovd	Khovd	9		1	2	2,000	10	12
Ulaanbaatar	Nalaikh	UB central		2	2	500(2)	7.8	23
Dornogovi	Sainshand	3		1	2	1,000	54.2	14
Ovorkhangai	Arvaikheer	3		1	2	1,000	6.2	32
Bayan-Ulgii	Ulgii	2		1	2	2,000	20.5	11
Ulaanbaatar	Baganuur	4		2	7	1,000(2) 500(2) 500(3)	50.1	13
Selenge	Zuunkharaa	2						6+2
Uvs	Ulaangom	5		1	3	1,000	9	17
Bayankhongor	Bayankhongor	4		1	2	1,000	14.5	16
Population 10,000 – 20,000								
Selenge	Sukhbaatar	4		2	3	100 500(2)	35.5	28
Arkhangai	Tsetserleg	9	5	1	4	1,000-2,000	10	12
Gobi-Altai	Altai	5		1	2	1,000	14.7	6
Zavkhan	Uliastai	5		1	3	100(1) 500(1) 2,000(1)	11.3	7
Omnogovi	Dalanzadgad	3		1	2	1,000	12.8	16
Khentii	Undurkhaan	3	2	1	2	500	8.1	9
Tuv	Zuunmod	3		1	3	250, 1,000(2)	23	16
Bulgan	Bulgan	7			7	50(2) 1.5-5(5)	6.2	9
Sukhbaatar	Baruun Urt	3		5	2	1,000	28.4	16
Dornogovi	Zamiin-Uud	17						
Govisumber	Choir	3		1	2	500	4.5	6
Dundgovi	Mandalgovi	5	3	2	2	1,000	80	13
Population 5,000 – 10,000								
Khentii	Bor-Undur	4		2	8	2,000(4) 250(4)	42+	8
Selenge	Khotol	5		3	2	2,000	28	4
Total		**323**	**21**	**42**	**93**		**1,115.1**	**875**

Source: information from water supply companies in aimags and cities.

Annex 2. Aimag and Ulaanbaatar city 2008 and 2010 water consumption

Table 51. Aimag population 2008 and 2010 drinking water consumption

Aimag	Drinking water consumption 2008 (m^3/year)			Drinking water consumption 2010 (m^3/year)		
	urban	rural	total	urban	rural	total
Arkhangai	115,076	156,059	271,135	139,310	207,121	346,431
Bayan-Ulgii	197,644	144,706	342,350	232,565	175,559	408,124
Bayankhongor	276,887	122,714	399,601	308,818	157,937	466,755
Bulgan	120,872	102,220	223,093	135,668	136,455	272,122
Gobi-Altai	122,070	88,756	210,826	143,991	114,879	258,869
Dornogobi	492,439	53,042	545,481	544,842	72,492	617,334
Dornod	753,422	80,080	833,501	865,553	99,835	965,387
Dundgobi	147,986	82,574	230,560	162,025	103,934	265,960
Zavkhan	180,244	132,311	312,555	195,412	166,983	362,396
Uvurkhangai	224,753	169,475	394,228	262,881	225,725	488,606
Umnugobi	157,154	67,093	224,247	187,740	91,729	279,469
Sukhbaatar	165,236	89,442	254,677	185,601	118,421	304,022
Selenge	423,928	484,609	908,537	491,977	493,724	985,700
Tov	341,396	162,244	503,640	368,651	212,033	580,684
Uvs	267,554	120,728	388,282	297,043	151,481	448,524
Khovd	348,009	130,154	478,163	385,874	160,761	546,635
Khuvsgul	256,930	192,972	449,902	294,037	258,338	552,376
Khentii	772,633	96,161	868,794	831,393	126,842	958,235
Darkhan-Uul	3,851,999	43,317	3,895,316	3,792,884	52,648	3,845,533
Ulaanbaatar	34,292,657	8,195	34,300,852	38,496,214	10,649	38,506,863
Orkhon	3,326,110	14,318	3,340,428	3,496,448	8,523	3,504,972
Gobi-Sumber	110,899	11,388	122,287	124,242	15,479	139,720
Total	46,945,896	2,552,559	49,498,455	51,943,169	3,161,547	55,104,716

Table 52. Aimag drinking water use by municipal services (2008 and 2010)

Aimag	Drinking water use 2008 *(m^3)*			Drinking water use 2010 *(m^3)*		
	Commercial services	Public services	Total	Commercial services	Public services	Total
Arkhangai	14,820	109,209	124,029	15,600	114,956	130,556
Bayan-Ulgii	15,637	124,342	139,979	16,460	130,887	147,347
Bayankhongor	15,105	101,780	116,885	15,900	107,136	123,036
Bulgan	3,800	69,142	72,942	4,000	72,781	76,781
Gobi-Altai	3,610	76,892	80,502	3,800	80,939	84,739
Dornogobi	20,140	71,152	91,292	21,200	74,897	96,097
Dornod	12,160	110,246	122,406	12,800	116,049	128,849
Dundgobi	17,100	60,652	77,752	18,000	63,844	81,844
Zavkhan	6,555	100,246	106,801	6,900	105,522	112,422
Uvurkhangai	9,500	121,831	131,331	10,000	128,244	138,244
Umnugobi	4,522	59,168	63,690	4,760	62,282	67,042
Sukhbaatar	3,040	64,580	67,620	3,200	67,979	71,179
Selenge	42,750	143,077	185,827	45,000	150,608	195,608
Tov	1,520	94,176	95,696	1,600	99,133	100,733
Uvs	8,360	105,325	113,685	8,800	110,868	119,668
Khovd	20,900	124,362	145,262	22,000	130,908	152,908
Khuvsgul	10,536	143,539	154,075	11,090	151,094	162,184
Khentii	1,045	89,017	90,062	1,100	93,702	94,802
Darkhan-Uul	26,410	206,250	232,660	27,800	217,105	244,905

Aimag	Drinking water use 2008 *(m³)*			Drinking water use 2010 *(m³)*		
	Commercial services	Public services	Total	Commercial services	Public services	Total
Ulaanbaatar	3,410,595	3,079,571	6,490,166	3,590,100	3,241,654	6,831,754
Orkhon	29,735	190,129	219,864	31,300	200,136	231,436
Gobi-Sumber	2,185	23,421	25,606	2,300	24,654	26,954
Total	**3,680,025**	**5,268,108**	**8,948,133**	**3,873,710**	**5,545,377**	**9,419,087**

Table 53. Aimag industrial water use (2008)

Aimag	Industrial water use 2008 (m³/year)					
	Light and food	Heavy industries	Constructions	Energy	Mining	total
Arkhangai	18,304	0	3	12,600	1,796,388	1,827,294
Bayan-Ulgii	123,204	0	672	33,700	89,700	247,276
Bayankhongor	1,720	0	545,749	112,150	3,983,909	4,643,539
Bulgan	2,768	0	0	16,400	332,539	351,707
Gobi-Altai	21,017	0	3,148	130,000	4,605	158,770
Dornogobi	1,740	0	0	42,200	90,254	134,194
Dornod	20,316	0	0	2,900,000	3,166,659	6,086,975
Dundgobi	21,937	0	0	32,900	0	54,837
Zavkhan	2,606	0	0	153,800	0	156,406
Uvurkhangai	19,910	0	2,954	13,700	524,847	561,411
Umnugobi	887	0	0	800,000	194,324	995,211
Sukhbaatar	478	327,000	16	67,100	23,909	418,502
Selenge	114,808	2,115	400,384	225,600	8,162,854	8,905,762
Tov	124,338	0	1,124	255,000	8,536,304	8,916,767
Uvs	13,240	0	3	62,300	220,006	295,549
Khovd	8,598	0	4,431	39,300	0	52,372
Khuvsgul	12,284	0	0	63,300	0	75,584
Khentii	997	0	1,902	65,500	1,223,920	1,292,319
Darkhan-Uul	97,118	736,478	2,828	3,900,000	2,273,720	7,010,144
Ulaanbaatar	1,355,712	250,000	30,589	25,100,000	4,500,000	31,236,301
Orkhon	282,821	15,938	30,535	1,200,000	14,300,000	15,829,295
Gobi-Sumber	0	0	0	18,200	0	18,200
Total	2,244,803	1,331,532	1,024,336	35,243,750	49,423,938	89,268,414

Table 54. Aimag industrial water use (2010)

Aimag	Industrial water use 2010 *(m³/year)*					
	Light and food	Heavy industries	Con-structions	Energy	Mining	total
Arkhangai	1,099	0	1	20,000	1,145,684	1,166,784
Bayan-Ulgii	1,473	0	1,227	64,100	0	66,799
Bayankhongor	1,880	0	1,131	119,700	1,042,767	1,165,485
Bulgan	3,754	0	0	24,300	155,145	183,199
Gobi-Altai	54,672	0	0	131,300	0	185,972
Dornogobi	33,924	0	17	65,400	36,000	135,341
Dornod	72,038	0	0	3,100,000	4,287,519	7,459,557
Dundgobi	86,555	0	0	113,400	0	199,955
Zavkhan	3,197	0	0	160,000	0	163,197
Uvurkhangai	6,958	0	2,989	17,800	548,604	576,351
Umnugobi	782	0	0	900,000	1,401,020	2,301,802
Sukhbaatar	1,470	377,000	2,556	83,200	0	464,226
Selenge	102,254	2,829	476,185	160,000	4,420,270	5,161,553

Aimag	Industrial water use 2010 (m³/year)					
	Light and food	Heavy industries	Con-structions	Energy	Mining	total
Tov	6,261	0	681	279,500	5,983,457	6,269,899
Uvs	44,322	0	1,940	78,000	80,427	204,689
Khovd	19,388	0	109	31,100	0	50,597
Khuvsgul	22,793	0	0	35,000	0	57,793
Khentii	2,194	0	0	77,900	2,256,789	2,336,883
Darkhan-Uul	38,685	590,362	279,022	3,900,000	481,476	5,289,546
Ulaanbaatar	2,988,964	300,000	393,580	22,500,000	4,500,000	30,687,850
Orkhon	156,326	16,644	22,177	1,500,000	15,118,000	16,813,147
Gobi-Sumber	0	0	0	65,600	0	65,600
Total	3,648,988	1,286,835	1,181,615	33,426,300	41,457,158	81,006,224

Table 55. Aimag livestock water use (2008)

Aimag	Water use 2008 (m³/year)					
	Camel	Horse	Cattle	Sheep	Goat	Total
Arkhangai	15,230	2,069,262	2,961,519	2,062,507	1,501,079	8,609,597
Bayan-Ulgii	82,096	522,772	690,068	772,936	994,791	3,062,663
Bayankhongor	569,267	802,756	1,027,774	900,938	2,167,731	5,468,466
Bulgan	10,110	1,556,215	1,361,534	1,532,589	1,116,723	5,577,171
Gobi-Altai	561,798	646,139	352,330	982,583	2,036,342	4,579,192
Dornogobi	521,748	565,985	287,992	449,685	583,411	2,408,821
Dornod	131,258	1,274,394	1,039,384	879,703	654,093	3,978,832
Dundgobi	414,457	736,043	286,697	1,172,623	1,257,812	3,867,632
Zavkhan	137,564	1,133,474	1,257,270	1,986,050	1,655,085	6,169,443
Uvurkhangai	293,745	1,515,314	1,131,336	2,004,653	1,991,219	6,936,267
Umnugobi	1,680,814	464,596	104,132	448,672	1,517,033	4,215,247
Sukhbaatar	200,185	1,040,510	820,696	936,566	745,057	3,743,014
Selenge	13,792	489,063	1,126,049	832,516	766,185	3,227,605
Tov	49,455	1,863,499	1,440,214	1,852,116	1,490,200	6,695,484
Uvs	333,857	694,246	991,876	1,552,175	1,368,035	4,940,189
Khovd	368,290	779,972	917,582	1,104,224	1,796,539	4,966,607
Khuvsgul	47,622	1,330,091	2,909,489	2,066,995	2,167,902	8,522,099
Khentii	84,009	1,254,886	1,331,497	1,288,011	1,051,157	5,009,560
Darkhan-Uul	10,424	91,340	273,602	208,244	177,272	760,882
Ulaanbaatar	3,038	164,084	495,239	197,388	194,749	1,054,498
Orkhon	3,599	99,049	177,386	141,784	160,079	581,897
Gobi-Sumber	10,569	63,869	32,522	84,951	118,404	310,315
Total	**5,542,927**	**19,157,559**	**21,016,188**	**23,457,909**	**25,510,898**	**94,685,481**

Table 56. Aimag livestock water use (2010)

Aimag	Water use 2010 (m³/year)					
	Camel	Horse	Cattle	Sheep	Goat	Total
Arkhangai	18,829	1,717,767	2,534,869	1,695,862	1,089,389	7,056,716
Bayan-Ulgii	78,352	380,632	554,481	587,438	707,427	2,308,330
Bayankhongor	625,688	651,342	851,763	694,676	1,549,993	4,373,462
Bulgan	17,727	1,601,758	1,478,471	1,507,160	962,784	5,567,900
Gobi-Altai	506,476	339,450	154,049	506,203	1,070,293	2,576,471
Dornogobi	585,058	677,708	339,542	538,160	625,448	2,765,916
Dornod	124,099	1,193,978	905,351	703,630	399,074	3,326,132
Dundgobi	392,385	449,311	156,013	676,710	629,882	2,304,301
Zavkhan	121,251	818,168	618,719	1,097,460	875,987	3,531,585
Uvurkhangai	305,978	996,887	639,948	1,145,436	1,161,501	4,249,750
Umnugobi	1,742,732	329,559	63,231	271,906	854,095	3,261,523
Sukhbaatar	226,088	1,297,259	1,074,222	1,227,964	934,685	4,760,218
Selenge	16,395	541,361	1,204,397	782,026	571,525	3,115,704
Tov	46,333	1,750,482	1,443,855	1,735,794	1,249,280	6,225,744
Uvs	302,068	523,128	708,352	992,521	873,518	3,399,587
Khovd	339,933	566,334	680,113	759,149	1,127,841	3,473,370
Khuvsgul	47,581	1,302,558	2,622,792	1,742,423	1,627,530	7,342,884
Khentii	77,187	1,258,654	1,323,615	1,364,743	1,031,373	5,055,572
Darkhan-Uul	14,917	89,308	272,586	163,026	100,699	640,536
Ulaanbaatar	4,764	182,086	460,963	129,757	109,081	886,651
Orkhon	3,787	93,846	149,154	93,372	86,164	426,323
Gobi-Sumber	10,923	60,540	31,020	83,287	98,236	284,006
Total	**5,608,551**	**16,822,116**	**18,267,506**	**18,498,703**	**17,735,805**	**76,932,681**

Table 57. Aimag irrigation water use (2008, 2010)

Aimag	Water use 2008 (million m³/year)	Water use 2010 (million m³/year)
Arkhangai	756,500	1,082,210
Bayan-Ulgii	6,119,255	8,796,545
Bayankhongor	1,498,500	1,906,380
Bulgan	3,633,345	5,091,700
Gobi-Altai	5,362,620	10,715,656
Dornogobi	220,500	442,947
Dornod	1,522,175	3,214,590
Dundgobi	173,883	344,540
Zavkhan	906,270	2,171,025
Uvurkhangai	2,269,220	2,839,940
Umnugobi	874,240	743,651
Sukhbaatar	172,262	324,066
Selenge	17,059,415	23,601,121
Tov	5,439,530	3,117,916
Uvs	18,771,766	12,762,640
Khovd	5,871,285	5,562,938
Khuvsgul	988,965	1,255,105
Khentii	1,783,525	2,068,005
Darkhan-Uul	4,063,285	5,791,582
Ulaanbaatar	3,739,348	3,731,654
Orkhon	2,256,800	2,951,880
Gobi-Sumber	44,080	184,940
Total	**83,526,769**	**98,701,031**

Annex 3. River basin 2008 and 2010 water consumption and water use

Table 58. River basin drinking water consumption by urban and rural population.

№	River basin	City	Drinking water consumption 2008 (m^3)				Drinking water consumption 2010 (m^3)			
			Urban center	Soum center	Rural area	Total	Urban center	Soum center	Rural area	Total
1	Selenge			45,118	40,249	85,368		63,017	51,073	114,089
2	Khuvsgul - Eg			20,244	33,475	53,720		30,587	42,361	72,948
3	Shishkhid			5,696	13,557	19,253		8,010	18,450	26,460
4	Delgermurun	Moron	256,930	8,926	40,879	306,735	294,037	10,927	54,377	359,341
5	Ider			21,663	50,080	71,744		29,439	64,485	93,925
6	Chuluut			11,981	34,908	46,890		14,726	48,094	62,819
7	Khanui			7,409	37,055	44,464		10,436	49,156	59,592
8	Orkhon	Erdenet	3,326,110	489,900	120,861	4,515,931	3,496,448	479,849	156,915	4,800,207
		Bulgan	120,872				135,668			
		Tsetserleg	115,076				139,310			
		Sukhbaatar	322,946				365,621			
		Kharkhorin	20,166				26,397			
9	Tuul	Ulaanbaatar	34,223,941	43,789	68,572	34,677,699	38,400,715	58,236	89,425	38,917,028
		Zuunmod	341,396				368,651			
10	Kharaa	Darkhan	3,851,999	50,604	38,669	4,088,975	3,792,884	52,832	73,062	4,098,542
		Ulaanbaatar	12,045				16,936			
		Zuunkharaa/Mandal	135,658				162,828			
11	Eroo			14,290	6,020	20,310		22,099	6,680	28,779
12	Onon			11,388	17,907	29,295		14,726	22,507	37,233
13	Ulz			15,308	17,236	32,544		21,103	22,984	44,086
14	Kherlen	Undurkhan	233,079	47,306	81,060	1,171,537	260,828	71,666	93,412	1,370,021
		Choibalsan	753,422				865,553			
		Baganuur	56,671				78,563			
15	Buir lake - Khalkh			3,695	2,764	6,458		5,358	3,527	8,885
16	Menengiin Tal			7,766	17,014	24,780		10,798	22,691	33,489

№	River basin	City	Drinking water consumption 2008 (m^3)				Drinking water consumption 2010 (m^3)			
			Urban center	Soum center	Rural area	Total	Urban center	Soum center	Rural area	Total
17	Umard Goviin Guveet - Khalkhiin dundad tal	Baruun Urt	165,236	63,401	155,375	1,649,645	185,601	91,414	190,017	1,828,413
		Sainshand	467,195				504,549			
		Choir	110,899				124,242			
		Mandalgobi	147,986				162,025			
		Bor Undur	539,554				570,565			
18	Galba – Uush - Doloodiin Govi	Zamiin Uud	25,244	15,573	51,787	97,253	40,293	29,270	65,398	143,677
		Khanbogd	2,659				4,249			
		Tsogtsetsii	1,991				4,468			
19	Ongi	Arvakheer	204,587	20,130	43,686	420,909	236,484	22,691	58,920	497,119
		Dalanzadgad	152,505				179,024			
20	Altain Uvur Govi			20,849	64,384	85,233		28,461	82,150	110,611
21	Taats			10,332	34,916	45,249		12,670	48,091	60,761
22	Orog-Tui	Bayankhongor	276,887	5,709	22,674	305,270	308,818	7,510	29,085	345,413
23	Buuntsagaan-Baidrag			9,770	40,494	50,263		12,793	54,660	67,452
24	Khyargas Lake – Zavkhan	Altai	122,070	32,721	112,006	447,041	143,991	40,798	139,640	519,842
		Uliastai	180,244				195,412			
25	Khuisiin Govi - Tsetseg Lake			12,098	33,882	45,980		14,279	45,562	59,840
26	Uyench-Bodonch			5,503	23,374	28,877		6,637	30,603	37,240
27	Bulgan			10,468	18,626	29,094		11,934	25,047	36,981
28	Khar Lake - Khovd	Khovd	348,009	58,017	167,724	771,395	385,874	77,879	194,452	890,770
		Ulgii	197,644				232,565			
29	Uvs Lake - Tes	Ulaangom	267,554	28,166	70,945	366,664	283,016	40,676	85,483	409,174
Total			**46,945,896**	**1,092,378**	**1,460,180**	**49,498,455**	**51,929,142**	**1,295,974**	**1,865,573**	**55,090,689**

Table 59. River basin drinking water use by municipal services

№	River basin	City	Drinking water use 2008 (m^3)			Drinking water use 2010 (m^3)		
			Commercial services	Public services	Total	Commercial services	Public services	Total
1	Selenge		0	0	0			
2	Khuvsgul Lake - Eg		0	0	0			
3	Shishkhid		0	0	0			
4	Delgermurun	Moron	10,536	143,539	154,075	11,090	151,094	162,184
5	Ider		0	0	0			
6	Chuluut		0	0	0			
7	Khanui		0	0	0			
8	Orkhon	Erdenet	29,735	190,129	219,864	31,300	200,136	231,436
		Bulgan	3,800	69,142	72,942	4,000	72,781	76,781
		Tsetserleg	14,820	109,209	124,029	15,600	114,956	130,556
		Sukhbaatar	42,750	143,077	185,827	45,000	150,608	195,608
9	Tuul	Ulaanbaatar	3,410,595	3,079,571	6,490,166	3,590,100	3,241,654	6,831,754
		Zuunmod	1,520	94,176	95,696	1,600	99,133	100,733
10	Kharaa	Darkhan	26,410	206,250	232,660	27,800	217,105	244,905
11	Eroo		0	0	0			
12	Onon		0	0	0			
13	Ulz		0	0	0			
14	Kherlen	Undurkhan	1,045	89,017	90,062	1,100	93,702	94,802
		Choibalsan	12,160	110,246	122,406	12,800	116,049	128,849
15	Buir Lake - Khalkh		0	0	0			
16	Menengiin Tal		0	0	0			
17	Umard Goviin Guveet - Khalh.	Baruun Urt	3,040	64,580	67,620	3,200	67,979	71,179
		Sainshand	20,140	71,152	91,292	21,200	74,897	96,097
		Choir	2,185	23,421	25,606	2,300	24,654	26,954
		Mandalgobi	17,100	60,652	77,752	18,000	63,844	81,844
18	Galba – Uush - Doloodiin Govi		0	0	0			
19	Ongi	Arvakheer	9,500	121,831	131,331	10,000	128,244	138,244
		Dalanzadgad	4,522	59,168	63,690	4,760	62,282	67,042
20	Altain Uvur Govi		0	0	0			
21	Taats		0	0	0			
22	Orog-Tui	Bayankhongor	15,105	101,780	116,885	15,900	107,136	123,036
23	Buuntsagaan-Baidrag		0	0	0			
24	Khyargas Lake – Zavkhan	Altai	3,610	76,892	80,502	3,800	80,939	84,739
		Uliastai	6,555	100,246	106,801	6,900	105,522	112,422
25	Khuisiin Govi - Tsetseg Lake		0	0	0			
26	Uyench-Bodonch		0	0	0			
27	Bulgan		0	0	0			
28	Khar Lake - Khovd	Khovd	20,900	124,362	145,262	22,000	130,908	152,908
		Ulgii	15,637	124,342	139,979	16,460	130,887	147,347
29	Uvs Lake - Tes	Ulaangom	8,360	105,325	113,685	8,800	110,868	119,668
Total			3,680,024	5,268,108	8,948,133	3,873,710	5,545,377	9,419,087

Table 60. River basin industrial water use (2008)

№	River basin	Industrial water use 2008 (m³)					
		Light and food	Heavy In dustries	Con-structions	Energy	Mining	Total
1	Selenge					331,280	331,280
2	Khuvsgul Lake - Eg					0	0
3	Shishkhid					0	0
4	Delgermurun	12,284	0	0	63,300	0	75,584
5	Ider					0	0
6	Chuluut					0	0
7	Khanui					0	0
8	Orkhon	418,701	18,053	430,922	1,454,600	15,881,800	18,204,076
9	Tuul	1,480,050	250,000	31,713	25,355,000	8,346,039	35,462,803
10	Kharaa	97,118	736,478	2,828	3,900,000	5,903,850	10,640,274
11	Eroo					3,912,394	3,912,394
12	Onon					0	0
13	Ulz					2,990,049	2,990,049
14	Kherlen	21,313	0	1,902	2,965,500	5,723,920	8,712,635
15	Buir Lake - Khalkh					0	0
16	Menengiin Tal					200,519	200,519
17	Umard Goviin Guveet - Khalkhiin Dundad Tal	24,155	327,000	16	160,400	814,778	1,326,348
18	Galba – Uush - Doloodiin Govi					0	0
19	Ongi	20,797	0	2,954	813,700	1,011,265	1,848,716
20	Altain Uvur Govi					45,986	45,986
21	Taats					0	0
22	Orog-Tui	1,720	0	545,749	112,150	0	659,619
23	Buuntsagaan-Baidrag					3,637,787	3,637,787
24	Khyargas Lake – Zavkhan	23,623	0	3,148	283,800	314,565	625,136
25	Khuisiin Govi - Tsetseg Lake					0	0
26	Uyench-Bodonch					0	0
27	Bulgan					0	0
28	Khar Lake - Khovd	131,802	0	5,103	73,000	89,700	299,604
29	Uvs Lake - Tes	13,240	0	3	62,300	220,006	295,549
Total		**2,244,803**	**1,331,532**	**1,024,336**	**35,243,750**	**49,423,938**	**89,268,414**

Table 61. River basin industrial water use (2010)

№	River basin	Industrial water use 2010 (m^3)					
		Light and food	Heavy industries	Con-structions	Energy	Mining	Total
1	Selenge					25,200	25,200
2	Khuvsgul Lake - Eg					56,745	56,745
3	Shishkhid					0	0
4	Delgermurun	22,793	0	0	35,000	0	57,793
5	Ider					0	0
6	Chuluut					0	0
7	Khanui					0	0
8	Orkhon	263,433	19,473	498,363	1,704,300	16,540,409	19,025,993
9	Tuul	2,995,225	300,000	394,261	22,779,500	5,735,845	32,204,831
10	Kharaa	38,685	590,362	279,022	3,900,000	4,108,876	8,916,946
11	Eroo					669,317	669,317
12	Onon					42,558	42,558
13	Ulz					3,431,930	3,431,930
14	Kherlen	74,232	0	0	3,177,900	6,714,231	9,966,363
15	Buir Lake - Khalkh					0	0
16	Menengiin Tal					855,589	855,589
17	Umard Goviin Guveet - Khalhiin Dundad Tal	121,950	377,000	2,573	327,600	360,627	1,189,750
18	Galba – Uush - Doloodiin Govi					509,540	509,540
19	Ongi	7,740	0	2,989	917,800	1,223,097	2,151,626
20	Altain Uvur Govi					60,000	60,000
21	Taats					0	0
22	Orog-Tui	1,880	0	1,131	119,700	0	122,711
23	Buuntsagaan-Baidrag					1,042,767	1,042,767
24	Khyargas Lake – Zavkhan	57,869	0	0	291,300	52,767	401,936
25	Khuisiin Govi - Tsetseg Lake					0	0
26	Uyench-Bodonch					0	0
27	Bulgan					0	0
28	Khar Lake - Khovd	20,861	0	1,336	95,200	0	117,396
29	Uvs Lake - Tes	44,322	0	1,940	78,000	27,660	151,922
	Total	**3,648,988**	**1,286,835**	**1,181,615**	**33,426,300**	**41,457,158**	**81,006,224**

Table 62. River basin livestock water use (2008, 2010)

№	River basin	Livestock water use 2008 (m^3)						Livestock water use 2010 (m^3)					
		Camel	Horse	Cattle	Sheep	Goat	Total	Camel	Horse	Cattle	Sheep	Goat	Total
1	Selenge	2,706	517,390	1,014,937	805,107	800,896	3,141,035	2,420	509,047	1,001,828	709,505	607,827	2,830,628
2	Khuvsgul Lake - Eg	2,851	321,177	976,401	299,231	360,908	1,960,567	2,937	325,327	1,013,047	290,238	305,205	1,936,753
3	Shishkhid	5,345	130,803	378,380	98,560	92,858	705,946	4,902	126,457	343,536	93,308	79,901	648,104
4	Delgermurun	24,014	423,208	815,464	796,261	816,999	2,875,947	24,346	413,181	694,836	675,529	603,525	2,411,417
5	Ider	8,465	415,732	728,796	695,606	594,559	2,443,158	6,674	401,917	477,298	495,156	368,168	1,749,213
6	Chuluut	196	376,537	1,127,336	443,718	326,164	2,273,951	166	379,665	1,034,390	388,295	261,987	2,064,503
7	Khanui	989	686,560	791,101	798,102	453,220	2,729,971	1,524	672,493	730,344	685,290	360,967	2,450,618
8	Orkhon	33,343	2,460,992	2,569,393	2,288,554	1,938,335	9,290,616	38,102	2,011,114	2,162,280	1,790,994	1,309,414	7,311,903
9	Tuul	38,849	1,755,609	1,298,569	1,850,265	1,463,931	6,407,223	45,522	1,768,526	1,405,072	1,873,471	1,297,384	6,389,975
10	Kharaa	13,570	477,891	1,107,681	713,155	629,349	2,941,647	19,332	518,491	1,130,824	614,723	432,757	2,716,128
11	Eroo	1,308	66,903	209,884	122,823	111,147	512,066	2,294	77,344	229,597	133,616	97,544	540,395
12	Onon	9,895	286,730	537,650	252,778	222,368	1,309,421	9,980	315,144	568,007	272,314	214,251	1,379,695
13	Ulz	37,280	433,915	389,168	341,815	232,726	1,434,904	33,920	427,214	354,495	304,869	172,665	1,293,162
14	Kherlen	176,118	2,018,014	1,611,198	1,897,832	1,483,116	7,186,278	165,236	1,898,858	1,419,186	1,774,014	1,233,317	6,490,612
15	Buir Lake - Khalkh	6,915	57,596	82,413	27,074	20,011	194,009	7,313	63,776	95,224	29,664	16,700	212,678
16	Menengiin Tal	57,735	427,318	334,605	217,910	194,805	1,232,373	57,174	464,449	373,655	247,905	202,924	1,346,106
17	Umard Goviin Guveet - Khalhiin Dundad Tal	737,344	2,185,489	1,098,530	2,770,090	2,564,781	9,356,234	751,455	1,918,438	1,031,053	2,246,825	1,881,116	7,828,888
18	Galba – Uush - Doloodiin Govi	1,123,128	735,804	451,614	636,266	970,832	3,917,644	1,228,072	811,312	540,550	696,227	809,016	4,085,178
19	Ongi	552,918	460,325	305,632	668,322	855,732	2,842,929	517,254	221,441	133,634	268,091	352,870	1,493,290
20	Altain Uvur Govi	1,049,071	324,500	108,469	438,683	1,988,259	3,908,981	1,105,456	240,121	67,072	274,115	1,272,415	2,959,179
21	Taats	156,723	342,531	261,012	500,909	742,461	2,003,636	164,757	226,781	161,129	304,054	459,105	1,315,825
22	Orog-Tui	93,669	172,411	329,283	186,207	532,793	1,314,364	107,796	176,302	351,752	171,805	417,159	1,224,814
23	Buuntsagaan-Baidrag	82,188	395,686	482,474	416,813	801,271	2,178,432	86,839	312,183	354,621	327,427	600,835	1,681,903
24	Khyargas Lake – Zavkhan	441,907	1,386,296	1,197,251	2,342,724	2,412,364	7,780,542	391,152	827,003	522,084	1,231,825	1,299,793	4,271,857
25	Khuisiin Govi - Tsetseg Lake	281,650	380,298	249,260	556,962	932,782	2,400,954	271,726	245,770	162,436	346,697	508,118	1,534,747
26	Uyench-Bodonch	84,925	189,893	206,638	279,609	467,758	1,228,824	68,435	114,874	132,600	142,197	212,595	670,701
27	Bulgan	43,598	107,493	146,741	87,848	254,860	640,540	32,193	58,050	97,204	43,531	113,683	344,661
28	Khar Lake - Khovd	337,674	1,036,687	1,297,010	1,619,957	2,223,165	6,514,493	328,109	781,452	1,014,232	1,180,626	1,586,500	4,890,919
29	Uvs Lake - Tes	138,557	583,770	909,296	1,304,713	1,022,447	3,958,783	133,463	515,387	665,526	886,397	658,063	2,858,836
Total		**5,542,931**	**19,157,559**	**21,016,186**	**23,457,897**	**25,510,897**	**94,685,470**	**5,608,549**	**16,822,117**	**18,267,512**	**18,498,706**	**17,735,805**	**76,932,689**

Table 63. River basin irrigation water use (2008, 2010)

№	River basin	Water use 2008 (million m^3/year)	Water use 2010 (million m^3/year)
1	Selenge	11.6	13.7
2	Khuvsgul Lake - Eg	0.15	0.18
3	Shishkhid	0.00	0.00
4	Delgermurun	0.00	0.00
5	Ider	0.47	0.56
6	Chuluut	0.00	0.00
7	Khanui	0.00	0.00
8	Orkhon	10.4	12.3
9	Tuul	3.0	3.5
10	Kharaa	9.3	11.0
11	Eroo	1.67	1.97
12	Onon	0.00	0.00
13	Ulz	0.00	0.00
14	Kherlen	4.6	5.4
15	Buir Lake - Khalkh	0.47	0.56
16	Menengiin Tal	0.00	0.00
17	Umard Goviin Guveet - Khalhiin Dundad Tal	0.62	0.73
18	Galba – Uush - Doloodiin Govi	0.21	0.25
19	Ongi	0.74	0.87
20	Altain Uvur Govi	2.4	2.9
21	Taats	0.22	0.26
22	Orog-Tui	1.87	2.21
23	Buuntsagaan-Baidrag	1.4	1.6
24	Khyargas Lake – Zavkhan	9.3	11.0
25	Khuisiin Govi - Tsetseg Lake	5.0	5.9
26	Uyench-Bodonch	0.4	0.4
27	Bulgan	1.3	1.6
28	Khar Lake - Khovd	8.6	10.2
29	Uvs Lake - Tes	9.9	11.6
Total		**83.5**	**98.7**

Annex 4. Aimag water demand

Table 64. Aimag drinking water demand by urban and rural population (2015, 2021)

Aimag	Low scenario						Medium scenario						High scenario					
	Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*		
	urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	0.25	0.27	0.52	0.31	0.40	0.71	0.27	0.27	0.53	0.33	0.41	0.74	0.29	0.26	0.55	0.37	0.41	0.78
Bayan-Ulgii	0.40	0.22	0.62	0.49	0.36	0.85	0.42	0.22	0.64	0.52	0.36	0.89	0.46	0.22	0.68	0.58	0.37	0.94
Bayankhongor	0.50	0.20	0.71	0.60	0.31	0.91	0.53	0.20	0.74	0.65	0.31	0.96	0.59	0.20	0.78	0.72	0.31	1.03
Bulgan	0.23	0.18	0.41	0.27	0.27	0.54	0.24	0.18	0.42	0.29	0.27	0.56	0.27	0.18	0.44	0.32	0.27	0.59
Gobi-Altai	0.25	0.15	0.39	0.30	0.23	0.53	0.26	0.15	0.41	0.32	0.24	0.56	0.28	0.14	0.43	0.37	0.24	0.61
Dornogobi	0.84	0.10	0.94	1.00	0.16	1.16	0.90	0.10	1.00	1.08	0.16	1.24	0.99	0.10	1.09	1.20	0.16	1.36
Dornod	1.22	0.13	1.35	1.24	0.22	1.46	1.30	0.13	1.43	1.34	0.22	1.56	1.44	0.13	1.57	1.53	0.22	1.75
Dundgobi	0.26	0.14	0.40	0.30	0.20	0.50	0.28	0.14	0.42	0.33	0.20	0.53	0.31	0.14	0.44	0.36	0.20	0.57
Zavkhan	0.32	0.22	0.55	0.37	0.32	0.69	0.34	0.22	0.56	0.40	0.32	0.73	0.37	0.22	0.59	0.44	0.33	0.77
Uvurkhangai	0.44	0.30	0.74	0.54	0.45	0.99	0.47	0.29	0.76	0.58	0.45	1.03	0.50	0.29	0.80	0.64	0.45	1.09
Umnugobi	0.36	0.12	0.47	0.55	0.18	0.73	0.38	0.12	0.49	0.58	0.18	0.77	0.41	0.11	0.52	0.63	0.19	0.82
Sukhbaatar	0.30	0.16	0.46	0.36	0.24	0.60	0.32	0.16	0.48	0.39	0.24	0.63	0.35	0.15	0.51	0.43	0.24	0.67
Selenge	0.76	0.54	1.31	0.91	0.63	1.54	0.81	0.54	1.35	0.99	0.63	1.62	0.89	0.53	1.42	1.09	0.64	1.72
Tov	0.57	0.29	0.85	0.64	0.42	1.06	0.60	0.28	0.89	0.70	0.42	1.12	0.66	0.28	0.95	0.78	0.42	1.20
Uvs	0.48	0.20	0.68	0.57	0.30	0.87	0.51	0.20	0.71	0.62	0.30	0.92	0.56	0.20	0.76	0.69	0.30	0.99
Khovd	0.62	0.21	0.83	0.73	0.32	1.05	0.66	0.21	0.87	0.79	0.32	1.11	0.73	0.21	0.93	0.88	0.32	1.20
Khuvsgul	0.51	0.33	0.84	0.62	0.50	1.12	0.53	0.33	0.86	0.66	0.51	1.17	0.58	0.32	0.90	0.73	0.51	1.24
Khentii	0.95	0.17	1.12	1.00	0.25	1.25	1.01	0.17	1.18	1.09	0.26	1.34	1.10	0.17	1.27	1.19	0.26	1.44
Darkhan-Uul	4.10	0.07	4.17	4.06	0.09	4.16	4.38	0.07	4.45	4.42	0.09	4.52	4.87	0.07	4.94	4.99	0.09	5.08
Ulaanbaatar	48.02	0.02	48.05	47.33	0.03	47.36	51.32	0.02	51.35	51.39	0.04	51.42	57.07	0.02	57.09	57.71	0.04	57.75
Orkhon	4.79	0.02	4.81	4.77	0.02	4.80	5.13	0.01	5.15	5.20	0.02	5.22	5.68	0.01	5.69	5.83	0.02	5.85
Gobi-Sumber	0.20	0.02	0.22	0.23	0.03	0.27	0.21	0.02	0.23	0.25	0.03	0.29	0.23	0.02	0.25	0.28	0.03	0.32
Total	66.36	4.07	70.43	67.19	5.94	73.13	70.89	4.03	74.91	72.93	5.99	78.92	78.61	3.99	82.59	81.76	6.03	87.79

Table 65. Aimag drinking water demand by services and public services (2015, 2021)

Aimag	Low scenario						Medium scenario						High scenario					
	Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*		
	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total
Arkhangai	0.02	0.12	0.14	0.03	0.12	0.15	0.02	0.12	0.15	0.03	0.13	0.17	0.03	0.14	0.17	0.07	0.18	0.25
Bayan-Ulgii	0.02	0.14	0.16	0.03	0.14	0.17	0.02	0.14	0.16	0.04	0.15	0.19	0.03	0.16	0.19	0.07	0.20	0.27
Bayankhongor	0.02	0.11	0.13	0.03	0.12	0.14	0.02	0.11	0.14	0.04	0.12	0.16	0.03	0.13	0.16	0.07	0.16	0.24
Bulgan	0.00	0.08	0.08	0.01	0.08	0.09	0.01	0.08	0.08	0.01	0.08	0.09	0.01	0.09	0.10	0.02	0.11	0.13
Gobi-Altai	0.00	0.08	0.09	0.01	0.09	0.09	0.01	0.09	0.09	0.01	0.09	0.10	0.01	0.10	0.11	0.02	0.12	0.14
Dornogobi	0.03	0.08	0.10	0.03	0.08	0.12	0.03	0.08	0.11	0.05	0.09	0.13	0.04	0.09	0.13	0.09	0.12	0.21
Dornod	0.02	0.12	0.14	0.02	0.13	0.15	0.02	0.12	0.14	0.03	0.14	0.16	0.03	0.14	0.17	0.06	0.18	0.24
Dundgobi	0.02	0.07	0.09	0.03	0.07	0.10	0.03	0.07	0.09	0.04	0.07	0.11	0.04	0.08	0.11	0.08	0.10	0.18
Zavkhan	0.01	0.11	0.12	0.01	0.11	0.13	0.01	0.11	0.12	0.02	0.12	0.14	0.01	0.13	0.14	0.03	0.16	0.19
Uvurkhangai	0.01	0.13	0.15	0.02	0.14	0.15	0.01	0.14	0.15	0.02	0.15	0.17	0.02	0.16	0.18	0.04	0.20	0.24
Umnugobi	0.01	0.06	0.07	0.01	0.07	0.07	0.01	0.07	0.07	0.01	0.07	0.08	0.01	0.08	0.09	0.02	0.10	0.12
Sukhbaatar	0.00	0.07	0.07	0.01	0.07	0.08	0.00	0.07	0.08	0.01	0.08	0.09	0.01	0.08	0.09	0.01	0.10	0.12
Selenge	0.06	0.16	0.21	0.07	0.16	0.24	0.06	0.16	0.23	0.10	0.18	0.28	0.09	0.18	0.27	0.20	0.23	0.43
Tov	0.00	0.10	0.10	0.00	0.11	0.11	0.00	0.11	0.11	0.00	0.12	0.12	0.00	0.12	0.12	0.01	0.15	0.16
Uvs	0.01	0.11	0.13	0.01	0.12	0.13	0.01	0.12	0.13	0.02	0.13	0.15	0.02	0.13	0.15	0.04	0.17	0.21
Khovd	0.03	0.14	0.16	0.04	0.14	0.18	0.03	0.14	0.17	0.05	0.15	0.20	0.04	0.16	0.20	0.10	0.20	0.30
Khuvsgul	0.01	0.16	0.17	0.02	0.16	0.18	0.02	0.16	0.18	0.02	0.18	0.20	0.02	0.18	0.21	0.05	0.23	0.28
Khentii	0.00	0.10	0.10	0.00	0.10	0.10	0.00	0.10	0.10	0.00	0.11	0.11	0.00	0.11	0.12	0.00	0.14	0.15
Darkhan-Uul	0.03	0.22	0.26	0.05	0.23	0.28	0.04	0.23	0.27	0.06	0.25	0.32	0.05	0.26	0.32	0.12	0.33	0.46
Ulaanbaatar	4.47	3.36	7.83	5.83	3.50	9.33	5.18	3.48	8.65	8.04	3.78	11.81	7.07	3.94	11.01	15.92	4.99	20.91
Orkhon	0.04	0.21	0.25	0.05	0.22	0.27	0.05	0.21	0.26	0.07	0.23	0.30	0.06	0.24	0.31	0.14	0.31	0.45
Gobi-Sumber	0.00	0.03	0.03	0.00	0.03	0.03	0.00	0.03	0.03	0.01	0.03	0.03	0.00	0.03	0.03	0.01	0.04	0.05
Total	**4.83**	**5.74**	**10.57**	**6.29**	**5.99**	**12.27**	**5.59**	**5.94**	**11.53**	**8.67**	**6.46**	**15.13**	**7.62**	**6.75**	**14.37**	**17.18**	**8.54**	**25.72**

Table 66. Aimag light and food industrial water demand (2015, 2021)

Light and food industries	Total water demand *(million m³/year)*					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	2021	2015	2021	2015	2021
Arkhangai	0.001	0.002	0.002	0.002	0.002	0.004
Bayan-Ulgii	0.002	0.002	0.002	0.003	0.003	0.005
Bayankhongor	0.002	0.003	0.003	0.004	0.003	0.007
Bulgan	0.005	0.006	0.005	0.008	0.007	0.014
Gobi-Altai	0.067	0.084	0.076	0.114	0.099	0.202
Dornogobi	0.041	0.052	0.047	0.071	0.061	0.125
Dornod	0.088	0.111	0.101	0.150	0.130	0.266
Dundgobi	0.105	0.133	0.121	0.180	0.157	0.319
Zavkhan	0.004	0.005	0.004	0.007	0.006	0.012
Uvurkhangai	0.008	0.011	0.010	0.014	0.013	0.026
Umnugobi	0.001	0.001	0.001	0.002	0.001	0.003
Sukhbaatar	0.002	0.002	0.002	0.003	0.003	0.005
Selenge	0.124	0.157	0.143	0.213	0.185	0.377
Tov	0.008	0.010	0.009	0.013	0.011	0.023
Uvs	0.054	0.068	0.062	0.092	0.080	0.164
Khovd	0.024	0.030	0.027	0.040	0.035	0.072
Khuvsgul	0.028	0.035	0.032	0.047	0.041	0.084
Khentii	0.003	0.003	0.003	0.005	0.004	0.008
Darkhan-Uul	0.047	0.060	0.054	0.081	0.070	0.143
Ulaanbaatar	3.637	4.601	4.173	6.227	5.410	11.027
Orkhon	0.190	0.241	0.218	0.326	0.283	0.577
Gobi-Sumber	0.0	0.0	0.0	0.0	0.0	0.0
Total	**4.440**	**5.617**	**5.094**	**7.602**	**6.605**	**13.462**

Table 67. Aimag heavy industrial water demand (2015, 2021)

Heavy industries	Total water demand (million m³/year)					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	2021	2015	2021	2015	2021
Arkhangai	0.0	0.0	0.0	0.0	0.0	0.0
Bayan-Ulgii	0.0	0.0	0.0	0.0	0.0	0.0
Bayankhongor	0.0	0.0	0.0	0.0	0.0	0.0
Bulgan	0.0	0.0	0.0	0.0	0.0	0.0
Gobi-Altai	0.0	0.0	0.0	0.0	0.0	0.0
Dornogobi	0.0	0.0	0.0	0.0	0.0	0.0
Dornod	0.0	0.0	0.0	0.0	0.0	0.0
Dundgobi	0.0	0.0	0.0	0.0	0.0	0.0
Zavkhan	0.0	0.0	0.0	0.0	0.0	0.0
Uvurkhangai	0.0	0.0	0.0	0.0	0.0	0.0
Umnugobi	0.0	0.0	0.0	0.0	0.0	0.0
Sukhbaatar	0.459	0.580	0.526	0.785	0.682	1.391
Selenge	0.003	0.004	0.004	0.006	0.005	0.010
Tov	0.0	0.0	0.0	0.0	0.0	0.0
Uvs	0.0	0.0	0.0	0.0	0.0	0.0
Khovd	0.0	0.0	0.0	0.0	0.0	0.0
Khuvsgul	0.0	0.0	0.0	0.0	0.0	0.0
Khentii	0.0	0.0	0.0	0.0	0.0	0.0
Darkhan-Uul	0.718	0.909	0.824	1.230	1.069	2.178
Ulaanbaatar	0.365	0.462	0.419	0.625	0.543	1.107
Orkhon	0.020	0.026	0.023	0.035	0.030	0.061
Gobi-Sumber	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total	**1.566**	**1.981**	**1.796**	**2.681**	**2.329**	**4.747**

Table 68. Aimag energy and heat industrial water demand (2015, 2021)

Energy	Total water demand *(million m³/year)*					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	2021	2015	2021	2015	2021
Arkhangai	0.023	0.026	0.027	0.038	0.033	0.058
Bayan-Ulgii	0.073	0.084	0.086	0.122	0.104	0.187
Bayankhongor	0.135	0.157	0.160	0.227	0.195	0.348
Bulgan	0.027	0.032	0.033	0.046	0.039	0.071
Gobi-Altai	0.149	0.172	0.176	0.249	0.213	0.382
Dornogobi	0.074	0.086	0.088	0.124	0.106	0.190
Dornod	3.507	4.067	4.148	5.885	5.038	9.023
Dundgobi	0.128	0.149	0.152	0.215	0.184	0.330
Zavkhan	0.181	0.210	0.214	0.304	0.260	0.466
Uvurkhangai	0.020	0.023	0.024	0.034	0.029	0.052
Umnugobi	1.018	1.181	1.204	1.708	1.463	2.620
Sukhbaatar	0.094	0.109	0.111	0.158	0.135	0.242
Selenge	0.181	0.210	0.214	0.304	0.260	0.466
Tov	0.316	0.367	0.374	0.531	0.454	0.814
Uvs	0.088	0.102	0.104	0.148	0.127	0.227
Khovd	0.035	0.041	0.042	0.059	0.051	0.091
Khuvsgul	0.040	0.046	0.047	0.066	0.057	0.102
Khentii	0.088	0.102	0.104	0.148	0.127	0.227
Darkhan-Uul	4.412	5.117	5.219	7.403	6.338	11.352
Ulaanbaatar	25.457	29.522	30.110	42.712	36.567	65.491
Orkhon	1.697	1.968	2.007	2.847	2.438	4.366
Gobi-Sumber	0.074	0.086	0.088	0.125	0.107	0.191
Total	**37.819**	**43.858**	**44.732**	**63.453**	**54.325**	**97.294**

Table 69. Aimag mining water demand (2015, 2021)

Mining	Total water demand *(million m³/year)*					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	**2021**	2015	**2021**	2015	2021
Arkhangai	1.328	1.586	1.887	3.436	3.225	11.169
Bayan-Ulgii	0.250	0.250	0.500	0.500	0.615	0.615
Bayankhongor	1.209	1.443	1.718	3.127	2.936	10.166
Bulgan	0.180	0.215	0.256	0.465	0.437	1.512
Gobi-Altai	0.000	0.000	0.000	0.000	0.000	0.000
Dornogobi	3.542	4.750	7.059	9.508	8.711	11.913
Dornod	5.586	7.045	11.900	15.651	13.716	21.796
Dundgobi	0.153	0.183	0.217	0.396	0.372	1.287
Zavkhan	0.000	0.000	0.000	0.000	0.000	0.000
Uvurkhangai	0.636	0.759	0.904	1.645	1.544	5.348
Umnugobi	8.673	15.878	17.333	31.760	21.335	39.186
Sukhbaatar	0.000	0.000	0.000	0.000	0.000	0.000
Selenge	2.349	3.101	3.946	6.460	5.737	14.734
Tov	4.372	3.686	7.804	7.695	10.703	17.941
Uvs	0.093	0.111	0.132	0.241	0.226	0.784
Khovd	0.000	0.000	0.000	0.000	0.000	0.000
Khuvsgul	0.000	0.000	0.000	0.000	0.000	0.000
Khentii	2.616	3.124	3.718	6.768	6.354	22.001
Darkhan-Uul	0.558	0.666	0.793	1.444	1.356	4.694
Ulaanbaatar	2.500	2.500	5.000	5.000	6.150	6.150
Orkhon	7.500	7.500	15.000	15.000	18.450	18.450
Gobi-Sumber	1.450	1.450	2.900	2.900	3.567	3.567
Total	42.995	54.247	81.068	111.997	105.434	191.314

Table 70. Aimag construction, construction material industry water demand (2015, 2021)

Constructions	Total water demand *(million m³/year)*					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	2021	2015	2021	2015	2021
Arkhangai	0.0	0.0	0.0	0.0	0.0	0.0
Bayan-Ulgii	0.001	0.002	0.002	0.003	0.002	0.003
Bayankhongor	0.001	0.002	0.002	0.002	0.002	0.003
Bulgan	0.0	0.0	0.0	0.0	0.0	0.0
Gobi-Altai	0.0	0.0	0.0	0.0	0.0	0.0
Dornogobi	0.0	0.0	0.0	0.0	0.0	0.0
Dornod	0.0	0.0	0.0	0.0	0.0	0.0
Dundgobi	0.0	0.0	0.0	0.0	0.0	0.0
Zavkhan	0.0	0.0	0.0	0.0	0.0	0.0
Uvurkhangai	0.004	0.005	0.004	0.006	0.005	0.009
Umnugobi	0.0	0.0	0.0	0.0	0.0	0.0
Sukhbaatar	0.003	0.004	0.004	0.005	0.004	0.007
Selenge	0.579	0.733	0.665	0.992	0.767	1.359
Tov	0.001	0.001	0.001	0.001	0.001	0.002
Uvs	0.002	0.003	0.003	0.004	0.003	0.006
Khovd	0.0	0.0	0.0	0.0	0.0	0.0
Khuvsgul	0.0	0.0	0.0	0.0	0.0	0.0
Khentii	0.0	0.0	0.0	0.0	0.0	0.0
Darkhan-Uul	0.339	0.430	0.390	0.581	0.449	0.796
Ulaanbaatar	0.479	0.606	0.549	0.820	0.634	1.123
Orkhon	0.027	0.034	0.031	0.046	0.036	0.063
Gobi-Sumber	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1.438**	**1.819**	**1.650**	**2.462**	**1.903**	**3.371**

Table 71. Aimag total industries water demand (2015, 2021)

Total industries	Total water demand *(million m³/year)*					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	**2021**	2015	**2021**	2015	2021
Arkhangai	1.352	1.614	1.916	3.476	3.260	11.231
Bayan-Ulgii	0.326	0.338	0.590	0.627	0.724	0.811
Bayankhongor	1.348	1.605	1.882	3.361	3.135	10.524
Bulgan	0.212	0.252	0.293	0.519	0.483	1.597
Gobi-Altai	0.215	0.256	0.252	0.363	0.312	0.584
Dornogobi	3.657	4.888	7.194	9.703	8.879	12.229
Dornod	9.181	11.223	16.149	21.686	18.885	31.085
Dundgobi	0.387	0.465	0.490	0.791	0.713	1.936
Zavkhan	0.185	0.215	0.219	0.310	0.266	0.478
Uvurkhangai	0.668	0.798	0.942	1.700	1.591	5.434
Umnugobi	9.692	17.060	18.538	33.470	22.799	41.808
Sukhbaatar	0.558	0.696	0.643	0.952	0.824	1.646
Selenge	3.439	4.518	5.343	8.716	7.479	18.092
Tov	4.696	4.064	8.188	8.240	11.170	18.780
Uvs	0.238	0.285	0.301	0.486	0.437	1.180
Khovd	0.059	0.071	0.069	0.100	0.086	0.162
Khuvsgul	0.067	0.081	0.079	0.114	0.098	0.186
Khentii	2.707	3.230	3.825	6.921	6.484	22.236
Darkhan-Uul	6.075	7.182	7.280	10.739	9.282	19.162
Ulaanbaatar	32.444	37.699	40.258	55.395	49.313	84.912
Orkhon	9.435	9.769	17.280	18.254	21.237	23.517
Gobi-Sumber	1.524	1.536	2.988	3.025	3.674	3.758
Total	88.465	107.844	134.719	188.947	171.129	311.349

Table 72. Aimag livestock water demand (2015, 2021)

Livestock	Total water demand (million m³/year)					
	Low scenario		Medium scenario		High scenario	
Aimag	2015	2021	2015	2021	2015	2021
Arkhangai	9.5	11.9	10.0	12.5	10.9	12.1
Bayan-Ulgii	1.9	1.6	2.0	1.7	2.6	2.5
Bayankhongor	5.7	7.3	6.0	7.7	7.1	8.4
Bulgan	8.8	12.0	9.2	12.6	10.1	11.9
Gobi-Altai	3.2	3.7	3.3	3.9	4.2	4.8
Dornogobi	2.0	1.5	2.1	1.6	2.5	2.1
Dornod	3.5	3.1	3.7	3.3	4.1	3.5
Dundgobi	1.9	1.7	2.0	1.8	2.5	2.6
Zavkhan	4.5	4.9	4.7	5.2	5.6	5.9
Uvurkhangai	5.0	5.3	5.3	5.6	6.3	6.6
Umnugobi	3.5	3.7	3.7	3.9	4.3	4.5
Sukhbaatar	3.2	2.5	3.4	2.6	4.2	3.9
Selenge	5.5	8.3	5.7	8.8	6.1	7.7
Tov	9.3	12.7	9.8	13.4	10.9	12.9
Uvs	3.4	3.2	3.5	3.4	4.3	4.3
Khovd	3.8	3.8	4.0	4.0	4.9	5.0
Khuvsgul	8.1	8.3	8.6	8.7	9.8	9.5
Khentii	4.6	4.0	4.8	4.3	5.7	5.3
Darkhan-Uul	1.0	1.4	1.1	1.4	1.1	1.3
Ulaanbaatar	1.0	1.1	1.1	1.2	1.1	1.1
Orkhon	0.6	0.9	0.7	0.9	0.7	0.9
Gobi-Sumber	0.2	0.2	0.3	0.2	0.3	0.3
Total	**90.2**	**103.1**	**94.9**	**108.6**	**109.4**	**117.3**

Table 73. Aimag irrigation water demand (2015, 2021)

Irrigation	Total water demand (million m³/year)			
	Low scenario		High scenario	
Aimag	2015	2021	2015	2021
Arkhangai	1.4	1.8	2.2	3.9
Bayan-Ulgii	11.1	14.8	18.1	32.1
Bayankhongor	2.4	3.2	3.9	7.0
Bulgan	6.4	8.5	10.5	18.6
Gobi-Altai	13.6	18.0	22.1	39.1
Dornogobi	0.6	0.7	0.9	1.6
Dornod	4.1	5.4	6.6	11.7
Dundgobi	0.4	0.6	0.7	1.3
Zavkhan	2.7	3.6	4.5	7.9
Uvurkhangai	3.6	4.8	5.8	10.4
Umnugobi	0.9	1.2	1.5	2.7
Sukhbaatar	0.4	0.5	0.7	1.2
Selenge	29.9	39.6	48.6	86.1
Tov	3.9	5.2	6.4	11.4
Uvs	16.2	21.4	26.3	46.6
Khovd	7.0	9.3	11.5	20.3
Khuvsgul	1.6	2.1	2.6	4.6
Khentii	2.6	3.5	4.3	7.5
Darkhan-Uul	7.3	9.7	11.9	21.1
Ulaanbaatar	4.7	6.3	7.7	13.6
Orkhon	3.7	5.0	6.1	10.8
Gobi-Sumber	0.2	0.3	0.4	0.7
Total	**125.0**	**165.5**	**203.2**	**360.0**

Annex 5. River basin water demand

Table 74. River basin drinking water demand urban and rural population (2015, 2021)

	River basin	City	Low scenario						Medium scenario						High scenario					
			Drinking water demand 2015 (million m^3/year)			Drinking water demand 2021 (million m^3/year)			Drinking water demand 2015 (million m^3/year)			Drinking water demand 2021 (million m^3/year)			Drinking water demand 2015 (million m^3/year)			Drinking water demand 2021 (million m^3/year)		
			urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total	Urban	rural	total
1	Selenge			0.16	0.16		0.23	0.23		0.15	0.15		0.24	0.24		0.15	0.15		0.24	0.24
2	Khuvsgul Lake - Eg			0.10	0.10		0.15	0.15		0.10	0.10		0.15	0.15		0.10	0.10		0.15	0.15
3	Shishkhid			0.03	0.03		0.05	0.05		0.03	0.03		0.05	0.05		0.03	0.03		0.05	0.05
4	Delgermurun	Moron	0.51	0.08	0.59	0.62	0.13	0.74	0.53	0.08	0.62	0.66	0.13	0.79	0.58	0.08	0.66	0.73	0.13	0.86
5	Ider			0.12	0.12		0.18	0.18		0.12	0.12		0.18	0.18		0.12	0.12		0.19	0.19
6	Chuluut			0.08	0.08		0.12	0.12		0.08	0.08		0.12	0.12		0.08	0.08		0.12	0.12
7	Khanui			0.08	0.08		0.11	0.11		0.08	0.08		0.12	0.12		0.07	0.07		0.12	0.12
8	Orkhon – Tamir	Erdenet	4.79	0.73	5.52	4.77	0.93	5.70	5.13	0.73	5.86	5.20	0.93	6.13	5.68	0.72	6.40	5.83	0.93	6.76
		Bulgan	0.23		0.23	0.27		0.27	0.24		0.24	0.29		0.29	0.27		0.27	0.32		0.32
		Tsetserleg	0.25		0.25	0.31		0.31	0.27		0.27	0.33		0.33	0.29		0.29	0.37		0.37
		Sukhbaatar	0.59		0.59	0.68		0.68	0.63		0.63	0.74		0.74	0.69		0.69	0.82		0.82
		Kharkhorin	0.03		0.03	0.05		0.05	0.03			0.05		0.05	0.04		0.04	0.05		0.05
9	Tuul	Ulaanbaatar	47.83	0.20	48.03	47.04	0.29	47.33	51.13	0.19	51.32	51.08	0.30	51.38	56.86	0.19	57.06	57.40	0.30	57.70
		Zuunmod	0.56		0.56	0.64		0.64	0.60		0.60	0.70		0.70	0.66		0.66	0.78		0.78
10	Kharaa	Darkhan	4.10	0.17	4.27	4.06	0.26	4.32	4.38	0.17	4.55	4.42	0.26	4.68	4.87	0.17	5.04	4.99	0.26	5.25
		Ulaanbaatar	0.02		0.02	0.04		0.04	0.02		0.02	0.04		0.04	0.03		0.03	0.05		0.05
		Zuunkharaa	0.23		0.23	0.30		0.30	0.24			0.32		0.32	0.26		0.26	0.34		0.34
11	Eroo			0.04	0.04		0.06	0.06		0.04	0.04		0.06	0.06		0.04	0.04		0.06	0.06
12	Onon			0.05	0.05		0.08	0.08		0.05	0.05		0.08	0.08		0.05	0.05		0.08	0.08
13	Ulz			0.06	0.06		0.09	0.09		0.06	0.06		0.09	0.09		0.06	0.06		0.09	0.09
14	Kherlen	Undurkhan	0.42	0.22	0.64	0.49	0.34	0.83	0.45	0.22	0.67	0.54	0.34	0.87	0.50	0.22	0.72	0.59	0.34	0.93
		Choibalsan	1.22		1.22	1.24		1.24	1.30		1.30	1.34		1.34	1.44		1.44	1.53		1.53
		Baganuur	0.17		0.17	0.25		0.25	0.17		0.17	0.26		0.26	0.18		0.18	0.27		0.27
15	Buir Nuur - Khalkh g.			0.01	0.01		0.02	0.02		0.01	0.01		0.02	0.02		0.01	0.01		0.02	0.02
16	Menengiin Tal			0.04	0.04		0.07	0.07		0.04	0.04		0.07	0.07		0.04	0.04		0.07	0.07

	River basin	City	Low scenario						Medium scenario						High scenario					
			Drinking water demand 2015 (million m³/year)			Drinking water demand 2021 (million m³/year)			Drinking water demand 2015 (million m³/year)			Drinking water demand 2021 (million m³/year)			Drinking water demand 2015 (million m³/year)			Drinking water demand 2021 (million m³/year)		
			urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total	urban	rural	total	Urban	rural	total
17	Umard G guveet-Kh.	Baruun Urt	0.30	0.38	0.68	0.36	0.57	0.93	0.32	0.37	0.70	0.39	0.58	0.97	0.35	0.37	0.72	0.43	0.58	1.01
		Sainshand	0.78		0.78	0.91		0.91	0.84		0.84	0.99		0.99	0.93		0.93	1.11		1.11
		Choir	0.20		0.20	0.23		0.23	0.21		0.21	0.25		0.25	0.23		0.23	0.28		0.28
		Mandalgobi	0.26		0.26	0.30		0.30	0.28		0.28	0.33		0.33	0.31		0.31	0.36		0.36
		Bor Undur	0.52		0.52	0.51		0.51	0.56			0.55		0.55	0.60		0.60	0.59		0.59
18	Galba-Uush-Dol. G	Zamiin Uud	0.06	0.13	0.18	0.09	0.20	0.28	0.06	0.13	0.18	0.09	0.20	0.29	0.06	0.13	0.18	0.09	0.20	0.29
		Khanbogd	0.04		0.04	0.11		0.11	0.04			0.11		0.11	0.04		0.04	0.12		0.12
		Tsogtsetsii	0.03		0.03	0.08		0.08	0.03			0.09		0.09	0.03		0.03	0.09		0.09
19	Ongi	Arvakheer	0.41	0.11	0.51	0.49	0.16	0.65	0.43	0.11	0.54	0.53	0.16	0.69	0.47	0.10	0.57	0.59	0.16	0.75
		Dalanzadgad	0.30		0.30	0.36		0.36	0.31		0.31	0.38		0.38	0.34		0.34	0.42		0.42
20	Altain Uvur Govi			0.15	0.15		0.22	0.22		0.14	0.14		0.22	0.22		0.14	0.14		0.22	0.22
21	Taats			0.08	0.08		0.12	0.12		0.08	0.08		0.12	0.12		0.08	0.08		0.12	0.12
22	Orog-Tui	Bayankhongor	0.50	0.05	0.55	0.60	0.07	0.67	0.53	0.05	0.58	0.65	0.07	0.72	0.59	0.05	0.63	0.72	0.07	0.79
23	Baidrag-Buuntsagan			0.09	0.09		0.13	0.13		0.09	0.09		0.13	0.13		0.08	0.08		0.13	0.13
24	Zavkhan-Khyargas N	Altai	0.25	0.23	0.48	0.30	0.35	0.65	0.26	0.23	0.49	0.32	0.35	0.67	0.28	0.23	0.51	0.37	0.35	0.73
		Uliastai	0.32		0.32	0.37		0.37	0.34		0.34	0.40		0.40	0.37		0.37	0.44		0.44
25	Huisiin G-Tsetseg N			0.08	0.08		0.12	0.12		0.08	0.08		0.12	0.12		0.08	0.08		0.12	0.12
26	Uyench-Bodonch			0.05	0.05		0.07	0.07		0.05	0.05		0.07	0.07		0.05	0.05		0.07	0.07
27	Bulgan			0.05	0.05		0.07	0.07		0.05	0.05		0.07	0.07		0.05	0.05		0.08	0.08
28	Khar Lake - Khovd	Khovd	0.62	0.36	0.98	0.73	0.54	1.27	0.66	0.36	1.01	0.79	0.55	1.34	0.73	0.35	1.08	0.88	0.55	1.44
		Ulgii	0.40		0.40	0.49		0.49	0.42		0.42	0.52		0.52	0.46		0.46	0.58		0.58
29	Uvs Lake - Tes	Ulaangom	0.48	0.17	0.65	0.57	0.25	0.82	0.51	0.17	0.68	0.62	0.25	0.87	0.56	0.16	0.73	0.69	0.26	0.94
	Total		66.36	4.06	70.42	67.19	5.95	73.13	70.89	4.03	74.07	72.93	5.99	78.92	78.61	3.99	82.60	81.76	6.03	87.79

Table 75. River basin drinking water demand by municipal services (2015, 2021)

№	River basin	City	Low scenario						Medium scenario						High scenario					
			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*		
			Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total
1	Selenge																			
2	Khuvsgul Lake - Eg																			
3	Shishkhid																			
4	Delgermurun	Moron	0.01	0.16	0.17	0.02	0.16	0.18	0.02	0.16	0.18	0.02	0.18	0.20	0.02	0.18	0.21	0.05	0.23	0.28
5	Ider																			
6	Chuluut																			
7	Khanui																			
8	Orkhon – Tamir	Erdenet	0.04	0.21	0.25	0.05	0.22	0.27	0.05	0.21	0.26	0.07	0.23	0.30	0.06	0.24	0.31	0.14	0.31	0.45
		Bulgan	0.00	0.08	0.08	0.01	0.08	0.09	0.01	0.08	0.08	0.01	0.08	0.09	0.01	0.09	0.10	0.02	0.11	0.13
		Tsetserleg	0.02	0.12	0.14	0.03	0.12	0.15	0.02	0.12	0.15	0.03	0.13	0.17	0.03	0.14	0.17	0.07	0.18	0.25
		Sukhbaatar	0.06	0.16	0.21	0.07	0.16	0.24	0.06	0.16	0.23	0.10	0.18	0.28	0.09	0.18	0.27	0.20	0.23	0.43
9	Tuul	Ulaanbaatar	4.47	3.36	7.83	5.83	3.50	9.33	5.18	3.48	8.65	8.04	3.78	11.81	7.07	3.94	11.01	15.92	4.99	20.91
		Zuunmod	0.00	0.10	0.10	0.00	0.11	0.11	0.00	0.11	0.11	0.00	0.12	0.12	0.00	0.12	0.12	0.01	0.15	0.16
10	Kharaa	Darkhan	0.03	0.22	0.26	0.05	0.23	0.28	0.04	0.23	0.27	0.06	0.25	0.32	0.05	0.26	0.32	0.12	0.33	0.46
11	Eroo																			
12	Onon																			
13	Ulz																			
14	Kherlen	Undurkhan	0.00	0.10	0.10	0.00	0.10	0.10	0.00	0.10	0.10	0.00	0.11	0.11	0.00	0.11	0.12	0.00	0.14	0.15
		Choibalsan	0.02	0.12	0.14	0.02	0.13	0.15	0.02	0.12	0.14	0.03	0.14	0.16	0.03	0.14	0.17	0.06	0.18	0.24
15	Buir nuur - Khalkh g.																			
16	Menengiin Tal																			
17	Umard G guveet-Kh.	Baruun Urt	0.00	0.07	0.07	0.01	0.07	0.08	0.00	0.07	0.08	0.01	0.08	0.09	0.01	0.08	0.09	0.01	0.10	0.12
		Sainshand	0.03	0.08	0.10	0.03	0.08	0.12	0.03	0.08	0.11	0.05	0.09	0.13	0.04	0.09	0.13	0.09	0.12	0.21
		Choir	0.00	0.03	0.03	0.00	0.03	0.03	0.00	0.03	0.03	0.01	0.03	0.03	0.00	0.03	0.03	0.01	0.04	0.05
		Mandalgobi	0.02	0.07	0.09	0.03	0.07	0.10	0.03	0.07	0.09	0.04	0.07	0.11	0.04	0.08	0.11	0.08	0.10	0.18
18	Galba-Uush-Dol. G																			
19	Ongi	Arvakheer	0.01	0.13	0.15	0.02	0.14	0.15	0.01	0.14	0.15	0.02	0.15	0.17	0.02	0.16	0.18	0.04	0.20	0.24
		Dalanzadgad	0.01	0.06	0.07	0.01	0.07	0.07	0.01	0.07	0.07	0.01	0.07	0.08	0.01	0.08	0.09	0.02	0.10	0.12

№	River basin	City	Low scenario						Medium scenario						High scenario					
			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*			Drinking water demand 2015 *(million m³/year)*			Drinking water demand 2021 *(million m³/year)*		
			Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total	Com. serv.	Publ. serv.	Total
20	Altain Uvur Govi																			
21	Taats																			
22	Orog-Tui	Bayankhongor	0.02	0.11	0.13	0.03	0.12	0.14	0.02	0.11	0.14	0.04	0.12	0.16	0.03	0.13	0.16	0.07	0.16	0.24
23	Baidrag-Buuntsagan																			
24	Zavkhan-Khyargas N	Altai	0.00	0.08	0.09	0.01	0.09	0.09	0.01	0.09	0.09	0.01	0.09	0.10	0.01	0.10	0.11	0.02	0.12	0.14
		Uliastai	0.01	0.11	0.12	0.01	0.11	0.13	0.01	0.11	0.12	0.02	0.12	0.14	0.01	0.13	0.14	0.03	0.16	0.19
25	Huisiin G-Tsetseg N																			
26	Uyench-Bodonch																			
27	Bulgan																			
28	Khar Lake - Khovd	Khovd	0.03	0.14	0.16	0.04	0.14	0.18	0.03	0.14	0.17	0.05	0.15	0.20	0.04	0.16	0.20	0.10	0.20	0.30
		Ulgii	0.02	0.14	0.16	0.03	0.14	0.17	0.02	0.14	0.16	0.04	0.15	0.19	0.03	0.16	0.19	0.07	0.20	0.27
29	Uvs Lake - Tes	Ulaangom	0.01	0.11	0.13	0.01	0.12	0.13	0.01	0.12	0.13	0.02	0.13	0.15	0.02	0.13	0.15	0.04	0.17	0.21
Total			**4.8**	**5.7**	**10.6**	**6.3**	**6.0**	**12.3**	**5.6**	**5.9**	**11.5**	**8.7**	**6.5**	**15.1**	**7.6**	**6.7**	**14.4**	**17.2**	**8.5**	**25.7**

Table 76. River basin light and food and heavy industrial water demand (2015, 2021)

№	Industries	Light and food industries: Total water demand (million m^3/year)						Heavy industries: Total water demand (million m^3/year)			
		Low scenario		Medium scenario		High scenario		Low scenario		High scenario	
		2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
1	Selenge										
2	Khuvsgul Lake - Eg										
3	Shishkhid										
4	Delgermurun	0.028	0.035	0.032	0.047	0.041	0.084	0.000	0.000	0.000	0.000
5	Ider										
6	Chuluut										
7	Khanui										
8	Orkhon – Tamir	0.321	0.406	0.368	0.549	0.477	0.972	0.024	0.030	0.035	0.072
9	Tuul	3.644	4.611	4.181	6.240	5.422	11.050	0.365	0.462	0.543	1.107
10	Kharaa	0.047	0.060	0.054	0.081	0.070	0.143	0.718	0.909	1.069	2.178
11	Eroo										
12	Onon										
13	Ulz										
14	Kherlen	0.090	0.114	0.104	0.155	0.134	0.274	0.000	0.000	0.000	0.000
15	Buir Lake - Khalkh										
16	Menengiin Tal										
17	Umard Goviin Guveet - Kh.	0.148	0.188	0.170	0.254	0.221	0.450	0.459	0.580	0.682	1.391
18	Galba – Uush - Doloodiin Govi										
19	Ongi	0.009	0.012	0.011	0.016	0.014	0.029	0.000	0.000	0.000	0.000
20	Altain Uvur Govi										
21	Taats										
22	Orog-Tui	0.002	0.003	0.003	0.004	0.003	0.007	0.000	0.000	0.000	0.000
23	Buuntsagaan-Baidrag										
24	Khyargas Lake – Zavkhan	0.070	0.089	0.081	0.121	0.105	0.213	0.000	0.000	0.000	0.000
25	Khuisiin Govi - Tsetseg Lake										
26	Uyench-Bodonch										
27	Bulgan										
28	Khar Lake - Khovd	0.025	0.032	0.029	0.043	0.038	0.077	0.000	0.000	0.000	0.000
29	Uvs Lake - Tes	0.054	0.068	0.062	0.092	0.080	0.164	0.000	0.000	0.000	0.000
Total		**4.440**	**5.617**	**5.094**	**7.602**	**6.605**	**13.462**	**1.566**	**1.981**	**2.329**	**4.747**

Table 77. River basin construction industries and energy and heat industrial water demand (2015, 2021)

№	Industries	Constructions: Total water demand (million m³/year)						Energy: Total water demand (million m³/year)					
		Low scenario		Medium scenario		High scenario		Low scenario		Medium scenario		High scenario	
		2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
1	Selenge												
2	Khuvsgul Lake - Eg												
3	Shishkhid												
4	Delgermurun							0.040	0.046	0.047	0.066	0.057	0.102
5	Ider												
6	Chuluut												
7	Khanui												
8	Orkhon – Tamir	0.606	0.767	0.696	1.038	0.803	1.422	1.928	2.236	2.281	3.235	2.770	4.961
9	Tuul	0.480	0.607	0.550	0.821	0.635	1.125	25.773	29.889	30.484	43.242	37.021	66.304
10	Kharaa	0.339	0.430	0.390	0.581	0.449	0.796	4.412	5.117	5.219	7.403	6.338	11.352
11	Eroo												
12	Onon												
13	Ulz												
14	Kherlen							3.596	4.170	4.253	6.033	5.165	9.250
15	Buir Lake - Khalkh												
16	Menengiin Tal												
17	Umard Goviin Guveet - Kh.	0.003	0.004	0.004	0.005	0.004	0.007	0.371	0.430	0.438	0.622	0.532	0.954
18	Galba – Uush - Doloodiin Govi												
19	Ongi	0.004	0.005	0.004	0.006	0.005	0.009	1.038	1.204	1.228	1.742	1.492	2.671
20	Altain Uvur Govi												
21	Taats												
22	Orog-Tui	0.001	0.002	0.002	0.002	0.002	0.003	0.135	0.157	0.160	0.227	0.195	0.348
23	Buuntsagaan-Baidrag												
24	Khyargas Lake – Zavkhan							0.330	0.382	0.390	0.553	0.473	0.848
25	Khuisiin Govi - Tsetseg Lake												
26	Uyench-Bodonch												
27	Bulgan												
28	Khar Lake - Khovd	0.002	0.002	0.002	0.003	0.002	0.004	0.108	0.125	0.127	0.181	0.155	0.277
29	Uvs Lake - Tes	0.002	0.003	0.003	0.004	0.003	0.006	0.088	0.102	0.104	0.148	0.127	0.227
Total		**1.438**	**1.819**	**1.650**	**2.462**	**1.903**	**3.371**	**37.819**	**43.858**	**44.732**	**63.453**	**54.325**	**97.294**

Table 78. River basin mining and total industrial water demand (2015, 2021)

№	Industries	Mining: Total water demand *million m³/year*						Industrial total water demand *million m³/year*					
		Low scenario		Medium scenario		High scenario		Low scenario		Medium scenario		High scenario	
		2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
1	Selenge	0.029	0.035	0.042	0.076	0.071	0.246	0.029	0.035	0.042	0.076	0.071	0.246
2	Khuvsgul lake - Eg	0.066	0.079	0.093	0.170	0.160	0.553	0.066	0.079	0.093	0.170	0.160	0.553
3	Shishkhid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Delgermurun	0.0	0.0	0.0	0.0	0.0	0.0	0.067	0.081	0.079	0.114	0.098	0.186
5	Ider	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	Chuluut	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Khanui	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	Orkhon	16.649	16.969	17.343	19.266	19.005	28.867	19.730	20.721	21.086	24.870	23.614	37.438
9	Tuul	4.084	3.343	7.396	6.952	10.006	15.527	34.353	38.920	43.039	57.892	53.635	95.128
10	Kharaa	1.938	2.620	3.333	5.426	4.737	11.576	7.455	9.135	9.819	14.721	12.664	26.044
11	Eroo	0.826	0.976	1.203	2.107	2.007	6.648	0.826	0.976	1.203	2.107	2.007	6.648
12	Onon	0.049	0.059	0.070	0.128	0.120	0.415	0.049	0.059	0.070	0.128	0.120	0.415
13	Ulz	5.733	7.220	12.108	16.031	14.072	23.028	5.733	7.220	12.108	16.031	14.072	23.028
14	Kherlen	5.067	5.565	8.648	11.641	12.384	27.736	8.753	9.849	13.004	17.828	17.683	37.260
15	Buir lake-Khalkh gol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Menengiin Tal	0.006	0.008	0.009	0.017	0.016	0.054	0.006	0.008	0.009	0.017	0.016	0.054
17	Umard Goviin Guveet-Khalkhiin Dundad Tal	1.868	1.949	3.494	3.982	4.582	7.083	2.849	3.151	4.633	5.648	6.022	9.884
18	Galba-Uush-Doloodiin Govi	10.873	18.428	21.733	36.860	26.747	45.459	10.873	18.428	21.733	36.860	26.747	45.459
19	Ongi	0.904	0.992	1.545	2.074	2.210	4.925	1.955	2.213	2.788	3.839	3.720	7.633
20	Altain Uvur Govi	0.850	1.700	1.700	3.400	2.091	4.182	0.850	1.700	1.700	3.400	2.091	4.182
21	Taats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	Orog Lake-Tui	0.0	0.0	0.0	0.0	0.0	0.0	0.139	0.162	0.164	0.234	0.200	0.359
23	Buuntsagaan Lake-Baidrag	1.209	1.443	1.718	3.127	2.936	10.166	1.209	1.443	1.718	3.127	2.936	10.166
24	Khyargas Lake-Zavkhan	0.061	0.073	0.087	0.158	0.149	0.514	0.461	0.544	0.558	0.832	0.727	1.576
25	Khuisiin Govi-Tsetseg nuur	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	Uyench-Bodonch	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	Bulgan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	Khar Lake-Khovd	0.250	0.250	0.500	0.500	0.615	0.615	0.385	0.409	0.658	0.727	0.810	0.973
29	Uvs Lake-Tes	0.032	0.038	0.046	0.083	0.078	0.270	0.177	0.212	0.215	0.327	0.288	0.666
Total		50.495	61.747	81.068	111.997	101.984	187.864	95.965	115.344	134.719	188.947	167.679	307.899

Table 79. River basin agricultural water demand (2015, 2021)

№	Agriculture	Livestock: Total water demand (million m³/year)						Irrigation: Total water demand (million m³/year)					
		Low scenario		Medium scenario		High scenario		Low scenario		Medium scenario		High scenario	
		2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
1	Selenge	3.9	4.7	4.1	4.9	4.5	4.8	17.4	23.0	21.9	33.6	28.2	50.0
2	Khuvsgul Lake - Eg	2.0	1.8	2.1	1.9	2.2	1.9	0.23	0.30	0.3	0.4	0.4	0.7
3	Shishkhid	0.7	0.7	0.7	0.7	0.8	0.7	0.00	0.00	0.0	0.0	0.0	0.0
4	Delgermurun	2.6	2.6	2.8	2.8	3.3	3.2	0.00	0.00	0.0	0.0	0.0	0.0
5	Ider	2.2	2.4	2.3	2.5	2.7	2.7	0.71	0.93	0.9	1.4	1.1	2.0
6	Chuluut	2.8	3.9	3.0	4.1	3.0	3.5	0.00	0.00	0.0	0.0	0.0	0.0
7	Khanui	3.4	4.4	3.5	4.6	4.0	4.7	0.00	0.00	0.0	0.0	0.0	0.0
8	Orkhon – Tamir	10.9	14.2	11.4	14.9	12.5	14.2	15.5	20.6	19.6	30.0	25.2	44.7
9	Tuul	10.3	15.0	10.9	15.8	12.1	15.2	4.5	5.9	5.6	8.7	7.3	12.9
10	Kharaa	4.4	6.0	4.6	6.4	4.8	5.5	13.9	18.4	17.5	26.9	22.6	40.0
11	Eroo	0.7	0.8	0.8	0.9	0.8	0.8	2.50	3.31	3.2	4.8	4.1	7.2
12	Onon	1.5	1.5	1.6	1.6	1.7	1.6	0.00	0.00	0.0	0.0	0.0	0.0
13	Ulz	1.3	1.2	1.4	1.2	1.6	1.4	0.00	0.00	0.0	0.0	0.0	0.0
14	Kherlen	6.1	5.5	6.4	5.8	7.6	7.1	6.9	9.1	8.7	13.3	11.2	19.8
15	Buir Lake - Khalkh	0.3	0.3	0.3	0.3	0.3	0.3	0.71	0.93	0.9	1.4	1.1	2.0
16	Menengiin Tal	1.0	0.8	1.1	0.8	1.3	1.1	0.00	0.00	0.0	0.0	0.0	0.0
17	Umard Goviin Guveet - Khalhiin	6.4	5.6	6.7	5.9	8.4	8.3	0.92	1.22	1.2	1.8	1.5	2.7
18	Galba – Uush - Doloodiin Govi	3.5	3.1	3.6	3.2	4.2	4.0	0.32	0.42	0.4	0.6	0.5	0.9
19	Ongi	1.7	2.0	1.8	2.1	2.1	2.3	1.10	1.46	1.4	2.1	1.8	3.2
20	Altain Uvur Govi	3.3	3.8	3.5	4.0	4.4	5.0	3.7	4.8	4.6	7.1	6.0	10.5
21	Taats	1.6	1.8	1.7	1.9	2.1	2.3	0.32	0.43	0.4	0.6	0.5	0.9
22	Orog-Tui	1.8	2.3	1.9	2.5	2.1	2.6	2.80	3.70	3.5	5.4	4.5	8.1
23	Buuntsagaan-Baidrag	2.1	2.5	2.2	2.7	2.7	3.0	2.0	2.7	2.6	3.9	3.3	5.9
24	Khyargas Lake – Zavkhan	5.0	5.3	5.2	5.6	6.4	6.9	13.9	18.4	17.5	26.9	22.6	40.1
25	Khuisiin Govi - Tsetseg Lake	2.0	2.4	2.1	2.6	2.5	2.9	7.5	9.9	9.4	14.4	12.1	21.5
26	Uyench-Bodonch	0.7	0.7	0.7	0.7	0.9	0.9	0.5	0.7	0.7	1.0	0.9	1.5
27	Bulgan	0.3	0.3	0.3	0.3	0.4	0.4	2.0	2.7	2.5	3.9	3.3	5.8
28	Khar Lake - Khovd	4.7	4.4	5.0	4.6	6.2	6.3	12.9	17.1	16.3	4.9	21.0	37.2
29	Uvs Lake - Tes	3.0	3.0	3.2	3.2	3.8	3.8	14.7	19.5	18.6	28.5	24.0	42.5
Total		**90.2**	**103.1**	**94.9**	**108.6**	**109.4**	**117.3**	**125.0**	**165.5**	**157.6**	**241.7**	**203.2**	**360.0**

Part 5.
WASTE WATER TREATMENT AND SANITATION

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[1] *"Strengthening Integrated Water Resource Management in Mongolia" project*

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Introduction

The main sources polluting natural water resources are: municipal WWTPs, industrial WWTPs, semi-treated waste water discharged from public and private sanitation facilities and municipal and industrial solid and liquid waste discharged into nature. It is required to create a normal working condition of WWTPs, introduce modern technology and equipment, construct facilities with good solutions and conduct regular maintenance in order to decrease pollution and improve sanitation conditions.

This report was written based on research works conducted by state and scientific organizations, on data taken from local area organizations and entities and preliminary research work conducted by the project team. The technical condition of Mongolia's WWTP and sanitation facilities, the current operational condition of WWTPs and recommendations on further measures are included in this report.

The main objectives of the report are to provide general information on the current condition of WWTP and sanitation facilities; to make available required data for planning new WWTPs; to determine measures to be included in the IWRM plan.

Included in the annexes of the report are: the approved maximum amount of polluting substances in treated waste water and other indicator limits included in the standard "Water Quality and Treated Waste Water Standard Discharged into Environment (MNS 4943:2011)"; descriptions of WWTP technologies and investment cost overviews.

1. Available data and information used

1.1. Sanitation data

The description of latrines used in ger areas and in rural areas is obtained from the Manual on Low Cost Sanitation Technologies for Ger Areas, Mongolia 2006.

There are no recent data on sanitation facilities in ger areas and rural areas.

1.2. Waste water treatment data

The data on industrial and municipal waste water treatment plants was obtained from the WA. Some of this data was verified with the aimags. However it appears that the data is not up to date.

The required data for the waste water treatment is presented in Figure 1.

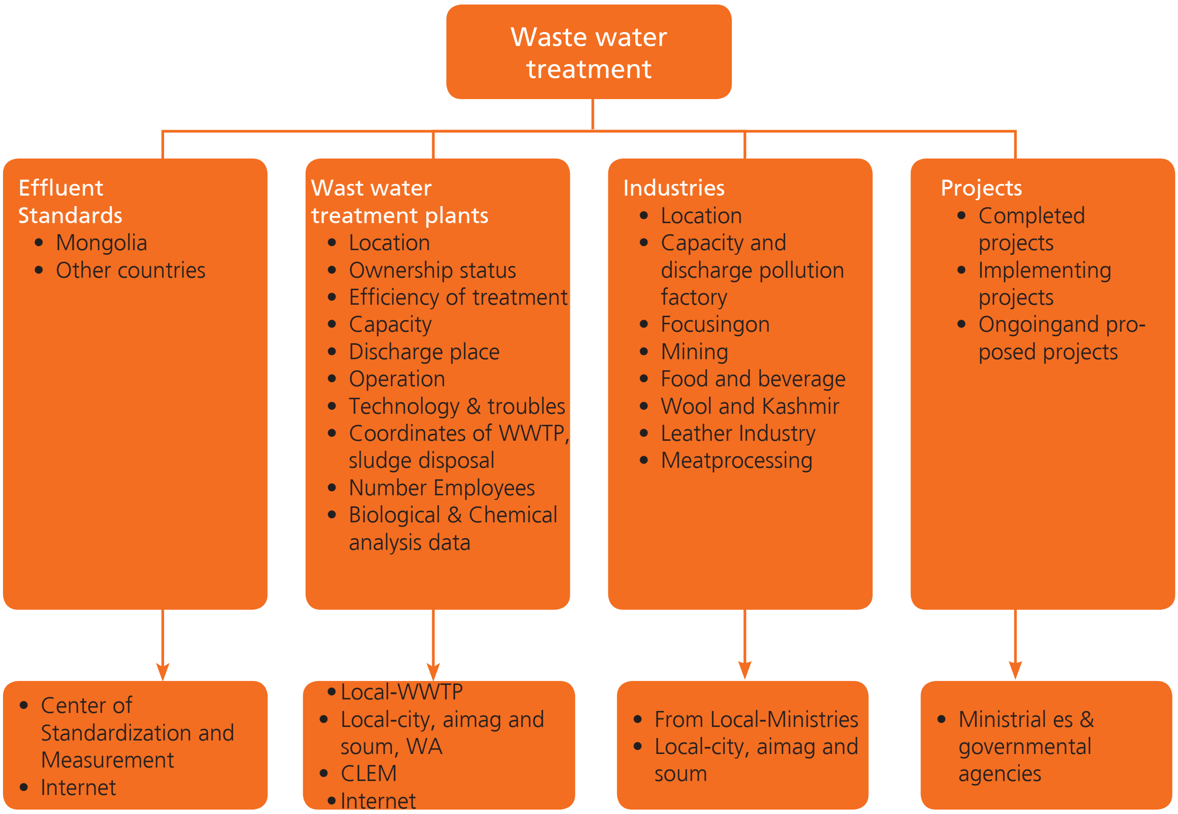


Figure 1. Waste water treatment required data

2. Methodology

2.1. Sanitation

The terminology of sanitation facilities and existing legislative national and international documents is defined as:

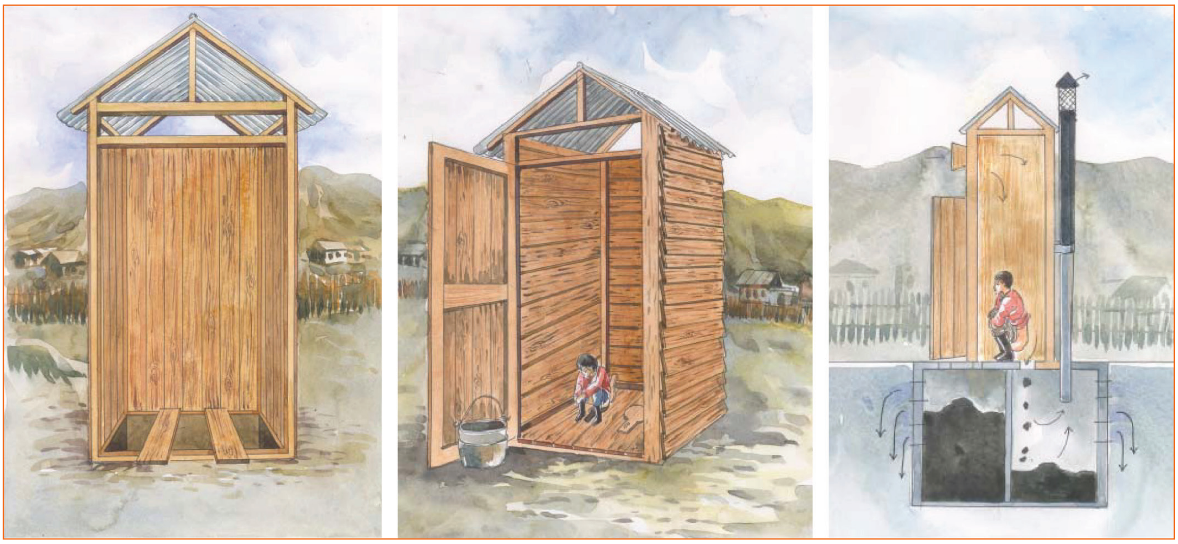
Sewerage: Pipelines and facilities designed to collect, discharge and treat waste water (clause 3.1.3. of Law on Urban water supply and sewerage usage)

WWTP: special facilities designed for continuous treatment of contaminants in waste water (Dictionary of Water Supply and Sanitation including terminology and description of waste water treatment standard MNS 6279:2011, clause 6.1.).

Sanitation: A complete system designed for disposal of wastes and waste water in a reliable manner without having any adverse impact to environment and public health. It includes disposal of human and animal excreta as well as disposal of collected solid and liquid wastes (Dictionary of Water Supply and Sanitation including terminology and description of waste water treatment standard MNS 6279:2011, clause 5.1.).

The description of the sanitation conditions in Mongolia in this report will cover the latrines used in ger areas of cities and used in rural arras. The text and figures are derived from the Manual on Low Cost Sanitation Technologies for Ger Areas, Mongolia 2006.

Source: *Manual on Low Cost Sanitation Technologies for Ger Areas, Mongolia 2006*



conventional pit latrine | *lid latrine* | *ventilated improved double pit latrine*

Figure 2. Sketches of pit latrines

The conventional pit latrine is the most widely used type of latrine. This latrine does not need water and is easy to construct. The conventional pit latrine is used both for private and communal use. Often these latrines are in unsanitary and unhygienic state.

The lid latrine is an improved conventional pit latrine with a lid to close the squat hole to reduce odour and insects. The latrine is better suited for use by children.

The ventilated improved double pit latrine is proposed as an improvement to the conventional latrine and is sometimes used for communal latrines. The latrine is also implemented with one chamber but the double chamber avoids insects to come in contact with excreta thereby reducing the chance of fly-borne transmission of diseases. The ventilation reduces odour significantly.

The Manual on Low Cost Sanitation Technologies for Ger Areas explains each latrine option. The options are arranged in ascending order, like a ladder - the sanitation ladder. The first option is offered without any hardware solution, the next step is a low-cost simple technology, and so on, through to the final option, which offers both improved technology with higher costs. This 'sanitation ladder' enables communities to decide on the option that is most suited to their requirement vis-a-vis their affordability.

The latrine options covered in the manual are:

- Option 1: Improve Traditional Practices
- Option 2: Conventional Pit Latrine
- Option 3: Lid Latrine
- Option 4: Ventilated Improved Single Pit Latrine
- Option 5: Ventilated Improved Double Pit Latrine

The latrines that are covered as potential options are:

- Option 6: Ecosan Toilet
- Option 7: Pour Flush Toilet – Single/Double Pits
- Option 8: Public Toilet and other facilities

The manual is aimed for the sanitation and hygiene workers of the local community-based organizations, Non-government Organizations and Khoroo/District authorities.

2.2. Overview of general water pollutants

In general water pollutants can be classified as shown in Table 1. In the Mongolian situation it is expected that in general all these pollutants are released by human activities (domestic and industrial activities).

Table 1. Water pollutants

Water Pollutants	Examples	Domestic	Industrial
Biodegradable Organic Pollutants	Food rests, excreta, etc	X	X
Persistent Organic Pollutants	Pesticides, solvents, polyvinyl chlorides, pharmaceuticals/medicines, hormones.	X	X
Nutrients	Nitrogen, phosphorus	X	X
Heavy metals	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sn, Tl		X
Solid particles; objects	Plastic, toilet paper, cans, tampons, hairs, condoms, twigs	X	X
Solid particles; sediment	Sand, silt, sludge, colloids	X	X
Pathogens	Bacteria, viruses	X	
Oil and grease	Oil, grease, fats	X	X
Salts	Sodium, Chloride, Sulfate		X

Based on the required effluent quality for each pollutant, different technologies for treatment and measures for sanitation can be considered. The next paragraphs describe the different pollutants which may or which may not be required to be hold back before discharging the waste water to the surface water or soil and to what extent preventative measures for release can be taken.

2.2.1. Biodegradable organic pollutants

The natural decomposition of organic pollutants in the receiving water body by the discharge of high loads of organic pollutants uses up so much of oxygen in the water that most or all fish or other creatures living in that receiving water body have an increased risk to die.

If an efficient removal of organic pollutants (faeces, spoiled food, etc.) is desired, biological treatment is the best treatment option. Organic pollutants are measured as COD (chemical oxygen demand) or BOD (biochemical oxygen demand). Biological treatment will remove practically all BOD and a large part of the COD, and with proper secondary sedimentation facilities installed it will be no problem to remove solids at the desired efficiency.

Although some nitrification occurs during the process, activated sludge treatment is first of all a biological process. This implies that the biological part, the bacteria clustered together in the activated sludge particles, have to be carefully monitored. Care should be taken that their average life time and living conditions are guaranteed. This should be the main concern of the plant's operator, so a basic understanding of the biological process is an absolute requirement.

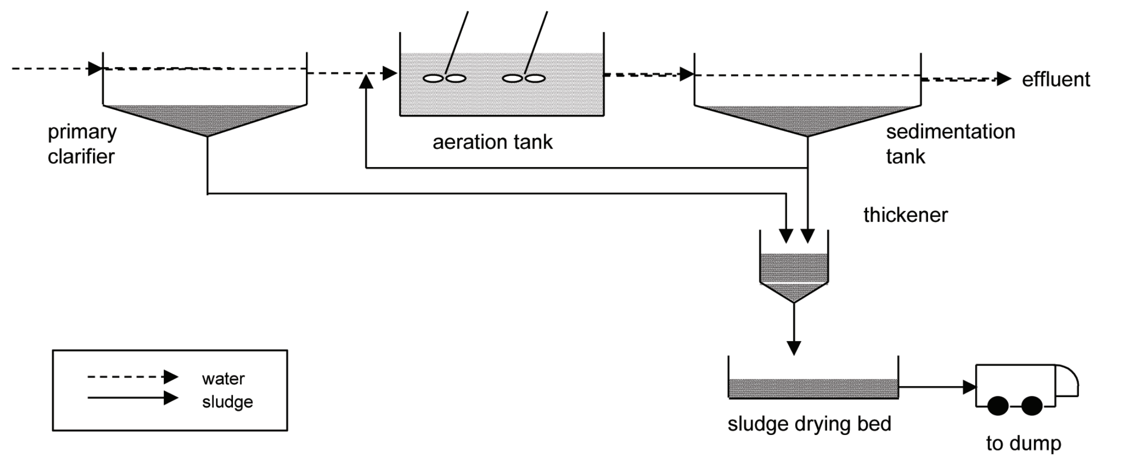


Figure 3. Schematic representation of an activated sludge system (primary clarification is not necessarily part of the system, but it usually is)

In the aeration tank, oxygen is supplied and the oxidation of COD (and BOD) takes place. The sludge is separated from the water in the final sedimentation tank, and from there, the sludge is returned to the aeration basin, or deposed to the sludge drying beds.

2.2.2. Persistent organic pollutants

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment.

Many POPs are currently or were in the past used as pesticides. Others are used in industrial processes and in the production of a range of goods such as solvents, polyvinyl chloride, and pharmaceuticals. Though there are a few natural sources of POPs, most POPs are created by humans in industrial processes, either intentionally or as byproducts.

POP exposure can cause death and illnesses including disruption of the endocrine, reproductive, and immune systems; neurobehavioral disorders; and cancers possibly including breast cancer. Exposure to POPs can take place through diet (mainly animal fats), environmental exposure, or accidents.

2.2.3. Nutrients

Waste water may contain high levels of the nutrients nitrogen and phosphorus. Excessive release to the environment can lead to a build up of nutrients, called eutrophication, which can in turn encourage the overgrowth of weeds, algae, and cyanobacteria (blue-green algae). This may cause an algal bloom, a rapid growth in the population of algae. The algae numbers are unsustainable and eventually most of them die. The decomposition of the algae by bacteria uses up so much of oxygen in the water that most or all of the animals die, which creates more organic matter for the bacteria to decompose. In addition to causing deoxygenation, some algal species produce toxins that contaminate drinking water supplies.

If Nitrogen (N) and/or Phosphate (P) removal is required, more complex system configurations need to be considered, such as:

- the Phoredox configuration;
- the UCT configuration (University of Cape Town process);
- the BCFS configuration (Biological-chemical phosphorus and nitrogen removal process);
- Etc.

2.2.4. Heavy metals

Motivations for controlling heavy metal concentrations in streams are diverse. Within the European community the 13 elements of highest concern are As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sn, and Tl. In general, consumption of high amounts of heavy metals is either toxic or carcinogenic. Unlike organic pollutants, heavy metals do not decay and thus pose a different kind of challenge for remediation. Heavy metals which are put into the environment by human activities will accumulate in the environment and finally will find their way back to humans either via water (drinking water or by eating fish) or via soil (by eating meat, vegetables, cereals).

Three main industries release considerable amounts of heavy metals:

- Tanneries which use and release chromium;
- Mining which use and release arsenic, mercury and cyanide;
- Steel companies: a variation of particles of heavy metals.

2.2.5. Solid particles (objects)

Solid particles found in domestic waste water (toilet paper, tampons, condoms, hairs, etc.) and directly discharged to the environment will form years of pollution before they finally will be decomposed in a natural way (some of them will hardly decompose).

Solid particles from tanneries and wool factories form a major problem for municipal waste water treatment plants because of the discharge of large amounts of hairs which block the mechanical screens.

2.2.6. Solid particles (sediment)

Sediment in water streams can cause high turbidity resulting in disturbance of the aquatic balance and erosion/waterway blockage.

Regarding the final disinfection step at a treatment plant, a high turbidity level will worsen the disinfection effect. The suspended solids interfere with water disinfection with chlorine because the particles act as shields for the virus and bacteria. Similarly, suspended solids can protect bacteria from ultraviolet (UV) disinfection of water. Regarding the drinking of surface water by people and livestock, this means that the higher the turbidity level of discharged effluent, the higher the risk that people or livestock may develop gastrointestinal diseases. This is especially problematic for immune-compromised people, because contaminants like viruses or bacteria can become attached to the suspended solid.

In water bodies such as lakes and reservoirs, high turbidity levels can reduce the amount of light reaching lower depths, which can inhibit growth of submerged aquatic plants and consequently affect species which are dependent on them, such as fish and shellfish.

2.2.7. Pathogens

A pathogen (more commonly germ), is a biological agent that causes disease or illness to its host. One of the primary pathways by which food or water become contaminated is from the release of untreated waste water into a drinking water supply or onto cropland, with the result that people who eat or drink contaminated sources become infected. Pathogens can be destroyed or inactivated by disinfection methods.

2.2.8. Oil and grease

Oils and greases will float and will form a layer on top of the water surface, reducing the oxygen level enough to kill fish and other aquatic life.

2.2.9. Salts

Salts like Sodium Chloride and Sulphate can disturb the natural balance once they are released in large amounts. Furthermore sulphates are converted into hydrogen sulphide (H_2S) after the anaerobic conversion of sulphate into sulphide. H_2S gasses form corrosion in e.g. concrete sewage networks.

2.3. Impacts on environment and health by water pollutants

A simplified overview of pollutants and related problems is shown in Table 2.

Table 2. Overview of existing problems on environment and health by water pollutants

Pollutants	General Problems		
	Environmental impact	Impact on livestock & crop irrigation	Human Health
Biodegradable Organic Pollutants	+	0	+
Persistent Organic Pollutants	(+)	(+)	(+)
Nutrients	+	0	(+)
Heavy metals	(+)	(+)	(+)
Solid particles (objects)	+	-	-
Solid particles (sediment)	+	0	(+)
Pathogens	+	+	+
Oil and grease	+	+	+
Sulphates	+	0	(+)
Sodium and chloride	+	0	(+)
+ = impact (+) = impact on long term 0 = impact unclear - = no impact			

Some of the impacts on environment and health are summarized in Table 3.

Table 3. Impacts on environment and health by water pollutants

Pollutants	Impacts	
	Environmental / Ecological impact	Human Health impact
Biodegradable Organic Pollutants	– Deoxygenation, enough to kill fish and other aquatic life.	– Bad smell of surface water.
Persistent Organic Pollutants	– Toxic accumulation in flora and fauna. – Mutation of fish due to hormones.	– Toxic accumulation in food and drinking water.
Nutrients	– In case of excessive release to the environment: eutrophication and deoxygenation enough to kill fish and other aquatic life.	– Risk of increased nitrate/nitrite contents in drinking water on long term; – Some algal species produce toxins that contaminate drinking water supplies.
Heavy metals	– Toxic accumulation in flora and fauna.	– Toxic accumulation in food (drinking water, fish, meat, vegetables, cereals).
Solid particles (objects)	– Forms years of pollution.	
Solid particles (sediment)	– High turbidity resulting in disturbance of the aquatic balance. – Erosion/waterway blockage (?)	– Higher risk that disinfection is not functioning properly, resulting in higher risk that people may develop diseases.
Pathogens	– Causes diseases to animal life.	– Causes disease or illness through contaminated water or food (irrigated crops).
Oil and grease	– Deoxygenation, enough to kill fish and other aquatic life. – Toxic to aquatic life.	– Drinking water contamination on long term.
Sulphates	– Disturbance of natural balance. – Corrosion of concrete sewage networks resulting in unidentified waste water leakages into the soil.	– Impure drinking water.
Sodium and Chloride	– Disturbance of natural balance.	– Impure drinking water.

2.4. Selection of preferred technologies

Each pollutant can be removed from the water with different kind of treatment technologies, as shown in Table 4.

The actual need for treatment in general is based on the two main key drivers:

- Impact on human health through both water resources and food supply;
- Environmental / ecological impact on flora and fauna.

Furthermore, a certain "grey zone" is the impact on livestock and crop irrigation (which is more or less related to indirect impacts on human health).

Table 4. Treatment technologies

Water Pollutants	Treatment Technology
Biodegradable Organic Pollutants	Activated sludge treatment (aerobe, anaerobe, MBR)
Persistent Organic Pollutants	UV, Active carbon filtration
Nutrients	Many N and P removal technologies
Heavy metals	Coagulation/flocculation, ion exchange, active carbon filtration, sand filtration, oxidation
Solid particles; objects	Screens, sieves, filtration
Solid particles; sediment	Sedimentation, Filtration, Coagulation/flocculation
Pathogens	UV, Chlorine, Ozone
Oil and grease	Oil separators or advanced Dissolved Air Flotation (DAF)
Salts	Ion exchange, Hyper filtration, Evaporation, anaerobic conversion (sulphates)

2.5. Waste water treatment standard

The waste water treatment standard (effluent standard) is developed to assess the level of treatment of a WWTP and to specify the required quality of the water discharged from the WWTP to the environment. The standard forms the basis for the planning of the operational level of WWTPs.

There are two standards: “Water quality. Standard for treated waste water to discharge into Environment MNS 4943: 2011” and “Allowed concentration for Effluent waste water from industries to the sewage system” (Annex 1).

The Ministry of Infrastructure, Nature and Environment, Health, Social security approved the “Allowed concentration for Effluent waste water from industries to the sewage system” on 10 January, 1997. There is no difficulty in treating waste water at the WWTP for domestic waste water from industries that meet the standard requirements. But heavy metals specified in this standard may cumulate in the sludge and there is a risk of difficulty in treating the sludge.

Since many industries and entities are being established newly or are organizing follow up works the allowed concentration for effluent waste water from industries to the sewage system needs to be upgraded.

Sludge standard

While studying regulation, law and standard it was found out that there is no standard in Mongolia on sludge disposal and its treatment. A description of sludge is included in:

“General requirements for selecting a site for wastewater treatment plants and treatment technologies and effectivness MNS 4288:1995” standard, and

“Water Supply and Sanitation. Terms and Definition-Vocabulary MNS 6279:2011 standard.

If the sludge amount from the WWTP is low, carry out dewatering by various methods and bury on specially prepared area that meet specific requirement. If sludge amount from the WWTP is large then carry out treatment at oxygen and oxygen free environment for disruptive oxidation.

Also there is experience in some country to combust at high temperature and use the rest of the sludge for road construction.

3. Waste water treatment technologies

3.1. Municipal waste water treatment technologies

3.1.1. Introduction on municipal waste water treatment

Conventional waste water treatment in general involves five stages, called pre-treatment, primary, secondary and tertiary treatment and sludge treatment (see Figure 4). The following paragraphs describe those stages.

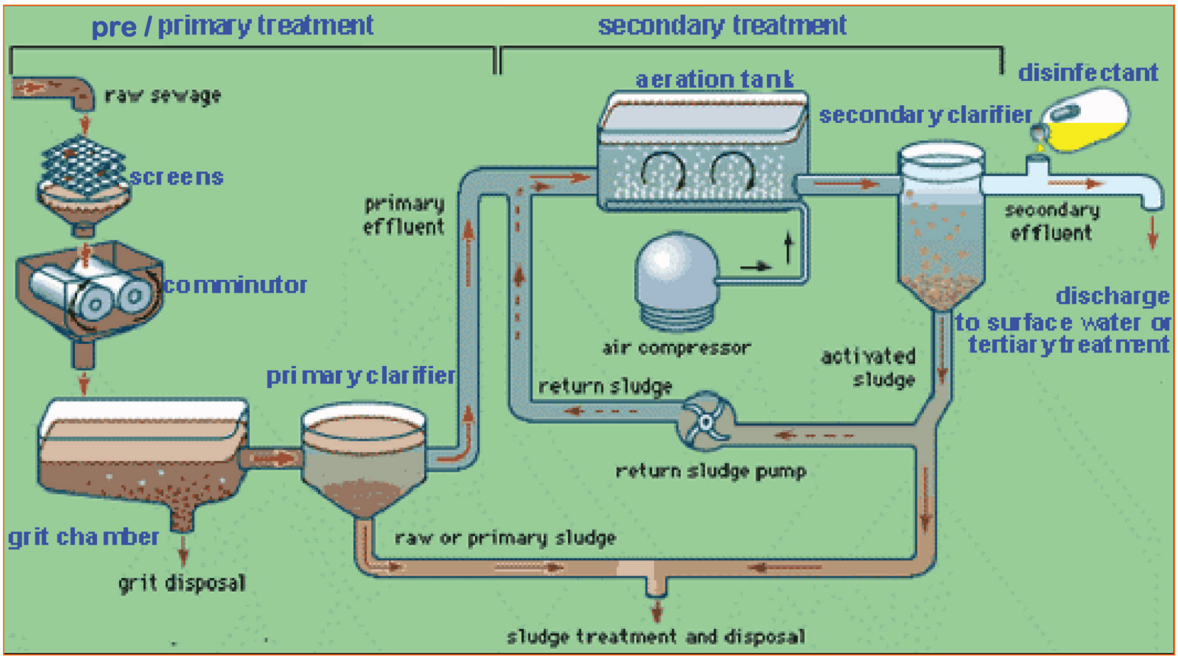


Figure 4. Process Flow Diagram for a typical large-scale treatment plant

3.1.2. Pre-treatment

Pre-treatment removes materials that can be easily collected from the raw waste water before they damage or clog the pumps and skimmers of primary treatment clarifiers.

Screening

The influent waste water is strained to remove all large objects carried in the sewage stream, such as twigs, tampons, cans, fruit, etc. This is most commonly done with an automated mechanically raked bar screen in modern plants serving large populations, whilst in smaller or less modern plants a manually cleaned screen may be used. The solids are collected and later disposed in a landfill or incinerated.

Comminutor

The comminutor consists of shredding and screening devices to disintegrate waste water solids.

Grit removal

Pre-treatment may include a sand or grit trap where the velocity of the incoming waste water is carefully controlled to allow sand, grit and stones to settle, while keeping the majority of the suspended organic material in the water column.

The contents from the sand catcher may be fed into the incinerator in a sludge processing plant, but in many cases, the sand and grit is sent to a landfill.

3.1.3. Primary treatment

In the primary sedimentation stage, waste water flows through large tanks, commonly called "primary clarifiers" or "primary sedimentation tanks". The tanks are large enough that sludge can settle and floating material such as grease and oils can rise to the surface and be skimmed off. The main purpose of the primary sedimentation stage is to produce both a generally homogeneous liquid capable of being treated biologically and a sludge that can be separately treated or processed. Primary settling tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank from where it can be pumped to further sludge treatment stages.

3.1.4. Secondary treatment

Biological degradation

Secondary treatment is designed to substantially degrade the biological content of the waste water such as are derived from human waste, food waste, soaps and detergent. The majority of municipal plants treat the settled waste water liquid using aerobic biological processes. For this to be effective, the organisms forming the activated sludge require both oxygen and a substrate on which to live. There are a number of ways in which this is done. In all these methods, the bacteria and protozoa consume biodegradable soluble organic contaminants (e.g. sugars, fats, organic short-chain carbon molecules, etc.) and bind much of the less soluble fractions into flocs. Apart from BOD reduction, also Nitrogen and/or Phosphate removal can be applied under aerobic, anaerobic and anoxic conditions.

Secondary sedimentation

The final step in the secondary treatment stage is to settle out the biological flock or filter material and produce waste water containing very low levels of organic material and suspended matter. Commonly these are called "secondary clarifiers" or "secondary sedimentation tanks".

3.1.5. Tertiary treatment

The tertiary treatment step is not shown in Figure 4 and in many cases is not part of a basic treatment plant (besides disinfection which is commonly applied). The purpose of tertiary treatment is to provide an extra final treatment stage to raise the effluent quality before it is discharged to the receiving environment. More than one tertiary treatment process may be used at any treatment plant. It is also called "effluent polishing". If disinfection is practiced, it is always the final process. Some examples of tertiary treatment are:

- Sand filtration (removes much of the residual suspended matter);
- Activated carbon Filtration (removes residual toxins);
- Lagooning (provides settlement and further biological improvement);
- Constructed wetlands (provides a high degree of aerobic biological improvement);
- Nutrient removal (Nitrogen and Phosphorus removal);
- Disinfection (Chlorination, Ultraviolet (UV) light, Ozone).
- Odour removal (mainly hydrogen sulfide capturing).

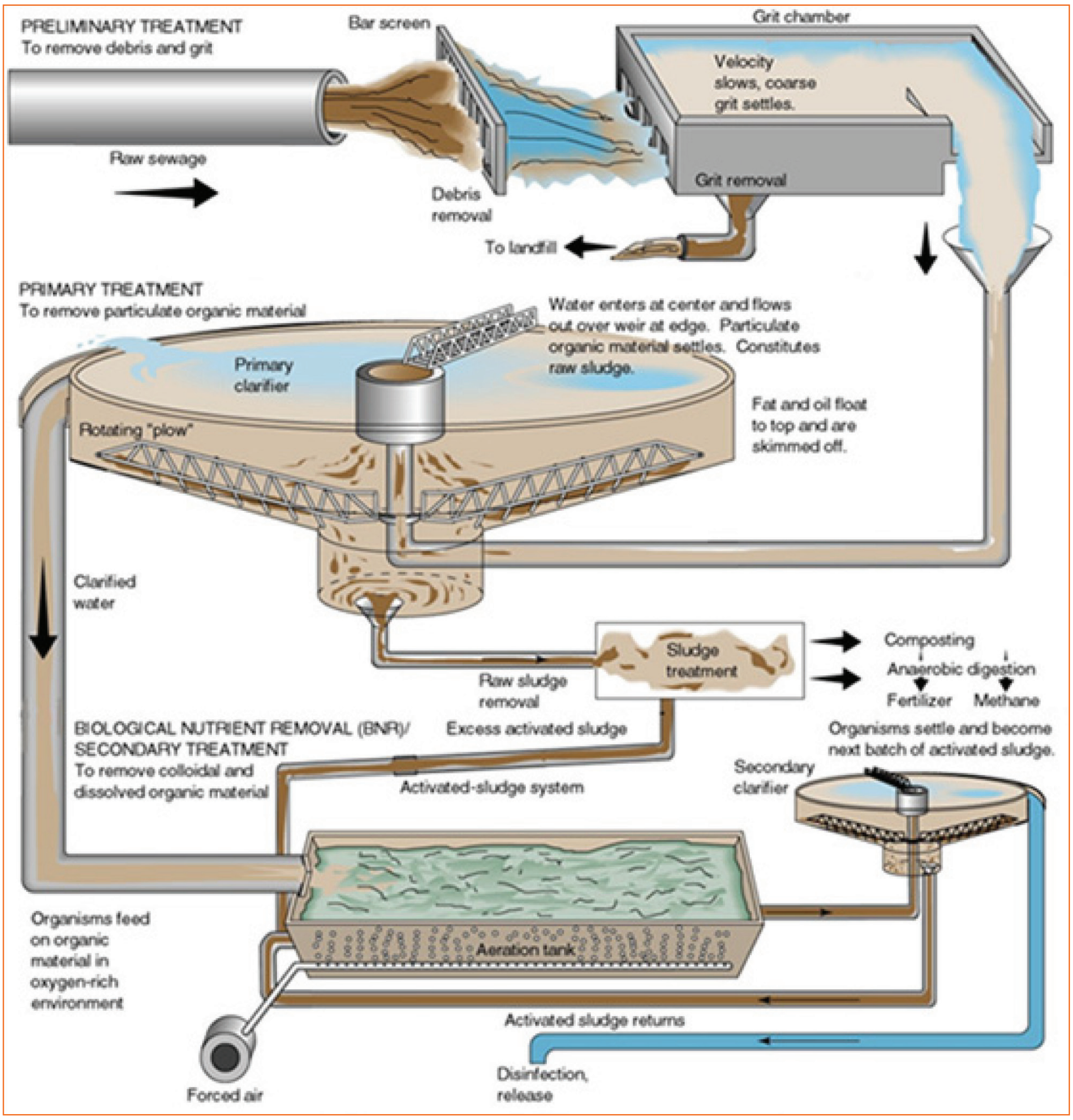


Figure 5. Example of a typical large-scale treatment plant

3.1.6. Sludge treatment

During the water treatment process sludge is released. Before sludge can disposed further, it requires several treatment steps. The objectives of sludge treatment are:

- reducing the sludge volume;
- reducing odour nuisance;
- improving hygienic reliability.

A distinction can be made between primary sludge (from the primary settling tanks) and secondary sludge (from the secondary settling tanks).

Sludge treatment is based on the removal of water and organic matter. The techniques applied are stabilisation, conditioning, sludge thickening, mechanical dewatering and thermal/ biological drying. The different technologies are described including the different options for sludge disposal (see also Figure 6).

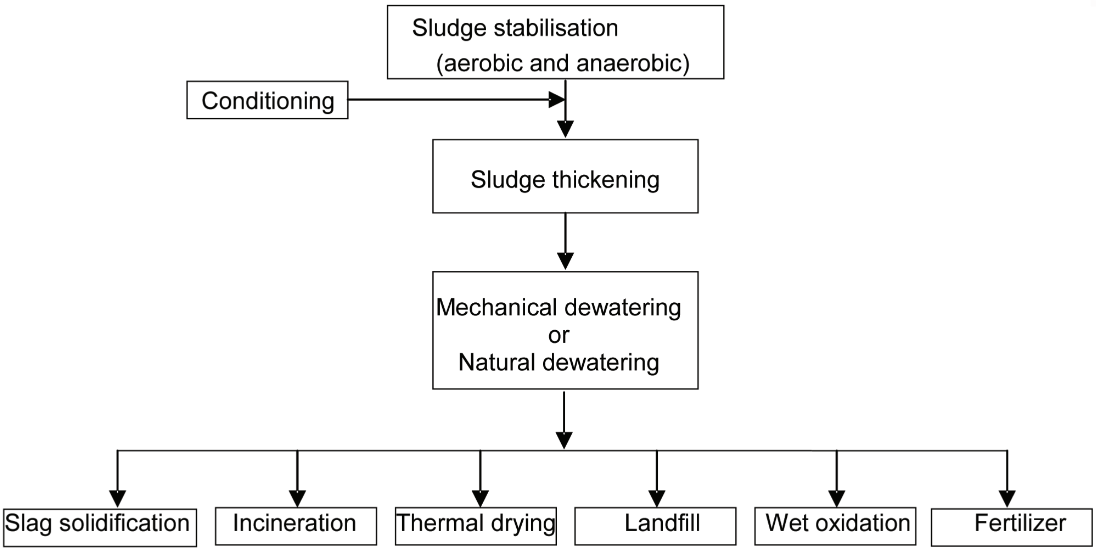


Figure 6. Options for sludge treatment

Sludge stabilisation
Biological sludge is subject to rotting. In order to prevent very unpleasant odors, the organic material needs to be reduced. The stopping of these rotting processes is called sludge stabilisation. Sludge stabilisation can be done biologically, chemically or thermally and with or without oxygen (aerobic or anaerobic). The anaerobic stabilisation process is called sludge digestion where the sludge is treated in a tank/reactor during a period of 20 to 30 days at a processing temperature between 30 to 35˚C. This results in the degradation of organic material by 20 to 50%. With the digestion process biogas is formed, a combination of methane and carbon dioxide (CO_2). This biogas can be burnt directly in a gas furnace to warm up the digestion tank and the buildings at the WWTP site.

The biogas can also be used for cogeneration (combined heat and power, CHP) which is the use of a heat engine to simultaneously generate both electricity and useful heat. The electricity can be used to drive the air compressor for the aeration process while the heat can be used to warm up the digestion reactor while the residual heat can be used to warm up buildings and/or the water in the aeration tank. In the Netherlands currently studies are carried out on how WWTPs can be operated energy-neutral. These studies show that there is high potential for energy-from-waste.

The released sludge after sludge stabilisation is called digested sludge. Aerobic stabilisation in aeration tanks is not widely applied because it requires a longer time. Therefore, anaerobic sludge stabilisation is the preferred technology.

Sludge conditioning
Before sludge can be thickened and dewatered, sludge needs to be conditioned in order to improve the thickening and dewatering characteristics of the sludge. Sludge conditioning can be done by chemical, physical and thermal conditioning:

- Chemical conditioning, adding chemicals like FeCl, CaO and $Ca(OH)_2$.
- Physical conditioning, adding aggregates like lime, granulates fly ash, paper pulp and sawdust.
- Thermal conditioning means freezing or heating the sludge in order to change the structure thus improving the thickening and dewatering characteristics of the sludge.

Sludge thickening
Sludge thickening is the first step to reduce the volume and mass of the sludge. Common methods are:

- Gravitation thickening, using gravity to obtain a dry weight of 4 - 7% (m/m) for primary sludge and 3 - 4% (m/m) for secondary sludge.
- Mechanical thickening, using different kind of installations such as belt thickeners, drum filters or centrifuges. The dry weight obtained varies between 5 and 8% (m/m).
- Flotation thickening. The most common technology for flotation thickening is Dissolved Air Flotation (DAF). The dry weight obtained varies between 3 and 8% (m/m).

Sludge dewatering
To further reduce the volume and mass (and thus reducing the costs for further sludge treatment and/or disposal) natural or mechanical dewatering can be applied:

- Natural dewatering, using sludge drying beds or lagoons to dewater the sludge either by drying (evaporating) or gravity (leaching). The disadvantages of this technology are odour nuisance, large required footprint, difficult process control and the introduction of sand and plant rests in the sludge.
- Mechanical dewatering, using belt filter presses, chamber type filter presses or centrifuges.

The Mongolian climate is very favorable to the natural solution (dry atmosphere and sub-zero conditions in winter). It has a very low cost, requires neither maintenance nor specific skills, but requires large surfaces (which in general are available in Mongolia). Once a heavy metal and chromium control plan is in use (preventing excessive amounts of heavy metals and particularly chromium pollution entering central WWTPs) landfill or fertilizer application of dewatered sludge does not imply direct environmental impacts.

Final sludge treatment and disposal
Before sludge can be disposed of, depending on the type of treatment, a final treatment can be required:

- Sludge drying, which can be done by thermal drying where a dry weight of 70 - 95% (m/m) can be obtained or by biological drying where a dry weight of 60 - 70% (m/m) can be reached. Composting is a type of biological drying which requires an ideal temperature of 55 - 70°C and a reaction time of 2 - 4 weeks.
- Sludge can be disposed of to landfills. However, in this case soil pollution caused by leaching of percolation water needs to be avoided by applying non-permeable landfill facilities. Furthermore, disposal in the near vicinity of river banks needs to be avoided in order to avoid direct pollution of drinking water resources. Normally a minimum dry weight of 35 - 40% (m/m) is requested.
- Incineration of sludge can be done by a separate sludge incinerator. The ashes can be used for civil constructions (roads or concrete constructions). Sludge can also be incinerated in an existing (coal fired) power plant or solid waste incinerator where the sludge is applied as extra fuel (co-incineration). Residual heat can be reused, for example to optimize the biological treatment process.
- Slag solidification, a process where the material is incinerated at very high temperatures (1200 - 1600°C). Ashes are smelted at these temperatures and volatile metals evaporate resulting in a relatively clean slag. Furthermore, the volume of ashes is reduced to 1/3 of the ashes which are formed with sludge incineration. The slag can be used in civil constructions. Slag solidification is mainly applied in Japan.

- Wet oxidation is a quite complex technology where sludge is oxidized at high temperatures (300˚C) and high pressure (100 bar) using a reactor which consists of a pipe construction constructed in the ground up to 1200 meter depth.
- Stabilized sludge can be used as a fertilizer where nitrogen and phosphorous are a wonderful source of nutrients for the soil. Using this material as a fertilizer can benefit the environment by turning wastes into valuable resources. Sludge would otherwise have to be disposed of by landfilling, incineration etc. On the other hand, heavy metals found in waste water sludge may present environmental problems. Concerns about applying sludge to land include the potential for applying too much or too little of each nutrient, the presence of toxic constituents and the possible detrimental effects on water quality from leaching, erosion or runoff losses. Because of these potential problems, restrictions need to be placed on land application of sludge. Steepness of slope and soil conditions may limit or prohibit application. Restrictions on how close sludge can be applied to homes, wells, streams, roads and property lines should be addressed as well.

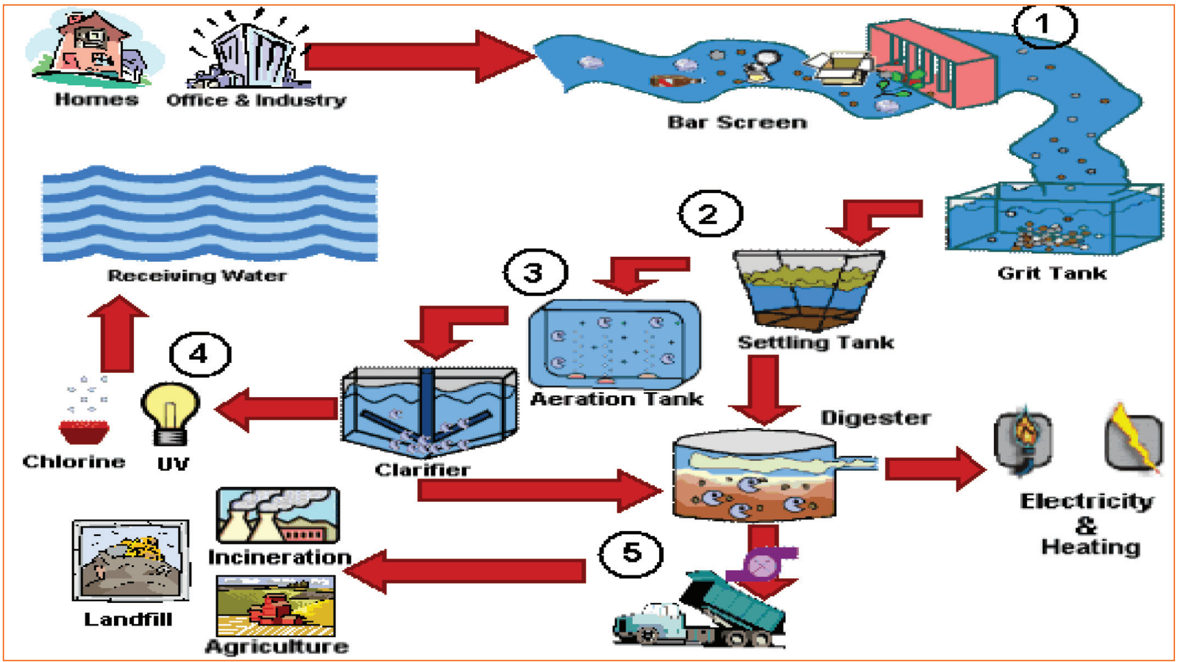


Figure 7. Waste water treatment and sludge management

Summary sludge treatment
The different possibilities of sludge disposal which are commonly applied are shown in Figure 8. The selection of the most favorable sludge disposal destination should be assessed after taking into account all relevant information.

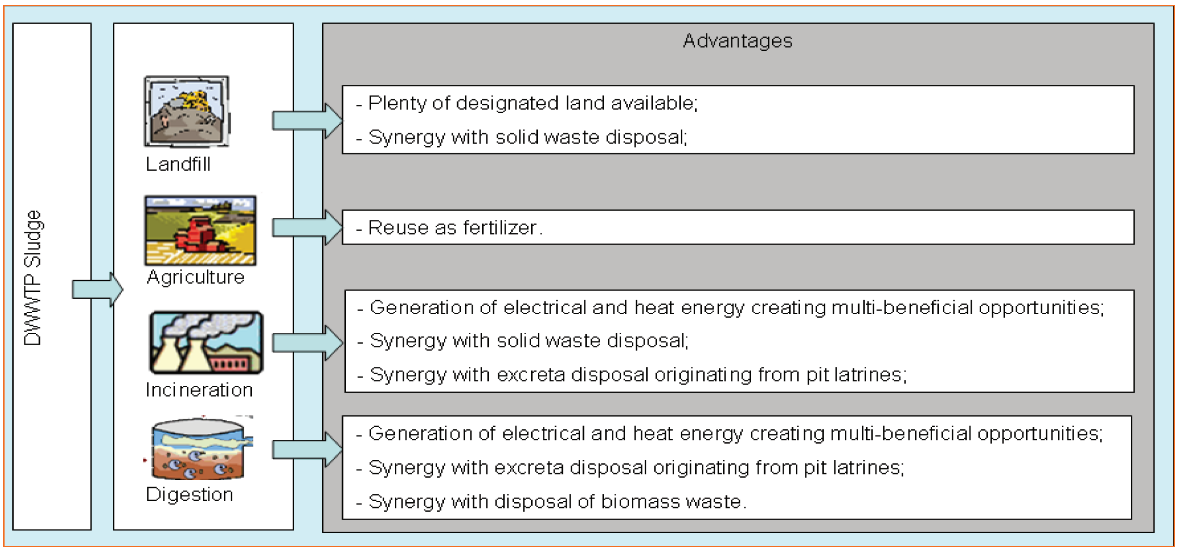


Figure 8. Overview of possible sludge disposal techniques

3.2. Industrial waste water treatment technologies

3.2.1. Introduction on industrial waste water treatment

Industrial waste water treatment plants are intended to treat the industrial effluent on-site or nearby the industry before transporting the effluent for further treatment to a central municipal WWTP (Figure 9).

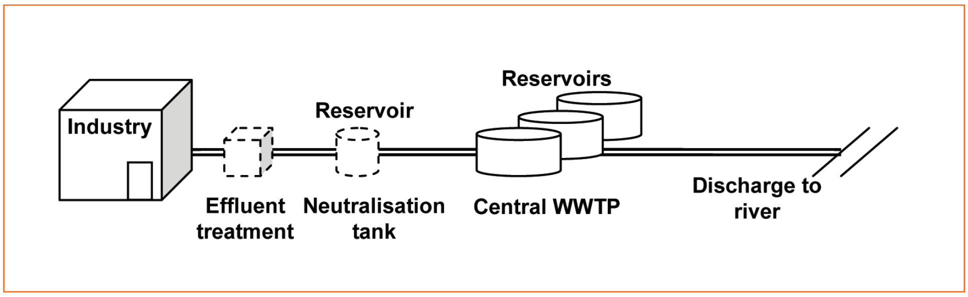


Figure 9. Principal set-up of an industrial effluent discharge

Main points of attention in relation to ensuring the functioning of receiving municipal WWTPs and prevention of blockages of sewage systems are:

- the discharge of hairs, fats and greases originating from slaughterhouses, tanneries, textile industries, restaurants, food industries;
- the discharge of possible acidic or basic/alkalic peak loads originating from industries like food and beverages production and packaging;
- the discharge of oils originating from petrol stations, car workshops and (petro) chemical industries;
- the discharge of heavy metals and chemicals, disturbing the biological process.

To avoid treatment problems at municipal WWTPs it should be mandatory for industries to implement a certain level of effluent treatment or effluent conditioning. Below the effluent treatment requirements are described for a number of industries.

3.2.2. Slaughterhouses

Typical waste water effluent

High water consumption and high BOD, COD and TSS concentrations arise during slaughter and carcass dressing. Solids break down, releasing colloidal and suspended fats and solids and leading to an increase in the BOD and COD. Other key contaminants are nitrogen and phosphorus, e.g. from the breakdown of proteins; copper and zinc from, e.g. pig feed residues and chloride, from hides/skins salting.

Typical waste water treatment

BOD/COD reduction
The BOD reduction is something what can be covered by the receiving central municipal WWTP and in many cases it is well appreciated to receive these high BOD loads to "feed" the activated sludge. In Europe (big) slaughterhouses exploit their own biological treatment plant, but this is done mainly because of financial drivers as companies are being charged (high discharge fees) based on BOD loads.

Particle removal
Large(r) particles discharged with the effluent will block the sewage system, sewage pump pits and (raked bar) screens of the municipal WWTP. Therefore, slaughterhouses always should prevent the discharge of large(r) particles by exploiting their own screens or sieves. Depending on the type of particles the screens or sieves can be manually cleaned or automatically cleaned. The investment costs of a (small to medium sized) manually cleaned system are relatively small and can be neglected. The investment and operational costs of a (large) automatically cleaned system are shown in Annex 4.

Fats and greases traps
Fats and greases, released during the slaughtering process, and discharged with the effluent will clog the sewage system and sewage pump pits. Therefore, slaughterhouses always should prevent the discharge of large amounts of fats and greases. This can be achieved by a flotation tank, where the suspended fats and greases will float at the water surface and can be skimmed off, either manually or automatically. A more sophisticated technology is a DAF system (Dissolved Air Flotation) of which both dissolved and suspended oils, fats and greases are forced to float by injecting air in the water. Normally the top layer of the DAF system is automatically skimmed off. The investment costs of a (small to medium sized) manually cleaned system are relatively small and can be neglected. The investment costs of a (large) DAF system are shown in Annex 4.

3.2.3. Tanneries

Typical waste water effluent tannery industry

Typical waste water effluent originating from tanning industries consists of:

- chemical oxygen demand (COD), biochemical oxygen demand (BOD5);
- suspended solids (SS)
- total nitrogen (N-tot, TKN), ammonium nitrogen (NH4-N);
- sulphide (S2-);
- chrome (total);
- Grease and fat.

The main concern is the high concentration of Chromium which is discharged by the tanneries and which are reported to be present at the entry of the Central WWTP at Ulaanbaatar. The situation will undoubtedly be the same at other WWTPs where tanneries are discharging to.

The Chromium presence will be a major mid-term concern because the high chromium concentration has two main consequences:

- The biological process is disturbed by this pollutant and negatively impacts the performance of municipal WWTP;
- The chromium remains in sludge which should be considered as dangerous waste.

Therefore sludge treatment is expensive as sludge can't be reused as fertilizer and landfills need to be improved to prevent leaching of heavy metals which implies groundwater pollution.

It is estimated that effective utilization of process chemicals leads to an up-take of about 15 % in the final product, implying that 85 % enters the waste or the waste water[1].

Typical waste water treatment

A typical tannery WWTP consists of:

- mechanical (pre)treatment

Grease removal (e.g. dissolved air flotation, see Fats and greases traps in paragraph 203.2.2);

Sulphide oxidation (liming and rinsing liquors);

Chromium precipitation (described below)

- primary treatment (physical-chemical treatment)
  - Mixing + Sedimentation, or;
  - Mixing + Chemical treatment + Sedimentation, or;
  - Mixing + Chemical treatment + Flotation.
- biological treatment;
  - Primary or chemical + Extended aeration, or;
  - Primary or chemical + Extended aeration with nitrification and denitrification, or;
  - Primary or chemical + Aerated facultative lagooning, and/or;
  - Anaerobic treatment (lagoon or UASB).
- sludge handling.

Annex 7 shows typical values of waste water treatment efficiency of tannery WWTPs.

Chromium precipitation

Because chrome precipitation is most effective if it is carried out in the separated effluent, it is common practice in the conventional chrome tanning process to segregate the chrome bearing effluent(s) from non-chrome-bearing effluent(s). The precipitated chrome is normally recovered and recycled into the tanning process. Where segregation of flows is not possible, thorough mixing of chrome-bearing effluents and other effluent streams improves the efficiency of the effluent treatment plant.

1 Source: IPPC BAT document Tanning of hides and skins.

3.2.4. Textile industries

Typical waste water effluent

The textile industry covers the whole range of activities like wool, cashmere, silk and cotton washing, cleaning and spinning, cloth and carpet production and final dying, coloring or bleaching processing.

Typical waste water effluents originating from textile industries consist of:

- Chemicals like dyes and bleaches;
- Reductive agents and hypochlorite (for equipment cleaning);
- Pigments (coloring);
- Active substances contents in the range of 5 – 25 %;
- COD of 10 to 200 g/litre.

The range of pollutants that can be found in the waste water varies widely depending on the type of finish applied. In particular, the release of the following substances in the environment gives rise to significant concerns:

- ethylene urea and melamine derivatives in their "not cross-linked form" (cross-linking agents in easy-care finishes);
- organo-phosphorous and poly brominated organic compounds (flame retardant agents);
- poly slogans and derivatives (softening agents);
- alky phosphates and alky lether phosphates (antistatic agents);
- fluorochemical repellents.

In addition, many substances are difficult to biodegrade or are not biodegradable at all and sometimes they are also toxic (e.g. biocides have a very low COD, but are highly toxic).

Typical waste water treatment

Finally, the effluent can be discharged to a municipal WWTP. Aerobic biological treatment techniques are widely used to treat textile waste water mixed with domestic waste water.

3.2.5. Steel industry

Typical waste water effluent

Typical waste water effluent originating from steel industries consists of:

- Rinsing water: suspended solids (including heavy metals);
- Cooling water: thermal pollution and high(er) salt concentration;
- Waste gas treatment: suspended solids (including heavy metals), organohalogen compounds such as PCDD/F and PCB, PAH, sulphur compounds, fluorides and chlorides.

Typical waste water treatment

Rinsing water
The type of processes in an iron and steel plant inherently cause dust deposition on the

plant premises. In order to prevent run-off to surface water, this should be removed, preferably by dry techniques. A few plants, however, do use rinsing water cleaning techniques. The resulting waste water contains suspended solids (including heavy metals) and is usually treated before discharge. For example, in a sinter plant with a production of approximately 11,000 tonnes of sinter per day, the rinsing water flow is about 460 m3/day. This waste water is treated by means of sedimentation in the recirculation circuit and (enhanced) settling prior to discharge.

Cooling water
In the sinter plant, cooling water can be used for the cooling of the ignition hoods and the fans as well as for the sinter machines. In integrated steelworks producing 4 Mt steel per year, the sinter plant cooling would require a water flow of approximately 600 m3 per hour. The cooling water is normally completely recycled. A bleed flow could be required in order to safeguard a good balance between scaling, (bio) fouling and corrosion. This bleed flow is thermally polluted and could have a high(er) salt content (TDS). Normally this stream is not treated before discharge.

Waste water from waste gas treatment
Waste water from waste gas treatment will only be generated if a wet abatement system is applied. The water flow contains suspended solids (including heavy metals), organ halogen compounds such as PCDD/F and PCB, PAH, sulphur compounds, fluorides and chlorides. It is usually treated before discharge with (enhanced) sedimentation and possibly filtration and active carbon absorption.

3.2.6. Power plants

Typical waste water effluent

Typical waste water effluent originating from power plants consists of:

- Solid substances (e.g. suspended solids);
- Fluid substances (e.g. oils, oil-water emulsions);
- Water soluble substances (organic and inorganic).

Typical waste water treatment

Concerning waste water from cooling systems, the discharge temperatures and concentration of biocides or other additives must be considered.

Waste water from flue gas cleaning systems is pre-neutralized with the dosing of lime. Flocculation and settling of heavy metal hydroxides then is followed.

Finally, in most occasions (including run-off storm water) oil separators are applied in order to prevent the release of oils and oil-water emulsions into the environment.

3.2.7. Food and beverage industries

Typical waste water effluent

Although this sector is an extremely diverse sector, certain sources of waste water are common to many of its sectors. These include:

- washing of the raw material;
- steeping of raw material;
- water used for transporting or fluming raw material or waste;
- cleaning of installations, process lines, equipment and process areas;

- cleaning of product containers;
- blow down from steam boilers;
- once-through cooling water or bleed from closed-circuit cooling water systems;
- backwash from regeneration of the WWTP;
- freezer defrost water;
- storm-water run-off.

The waste water is extremely variable in composition. It is, however, typically high in both COD and BOD. Levels can be 10 – 100 times higher than those of domestic waste water. The SS concentration varies from negligible to as high as 120,000 mg/l. Waste water from, e.g. the meat and dairy sectors contain high concentrations of edible fats and oils. Food processing waste waters vary from very acidic, i.e. pH 3.5, to very alkaline, i.e. pH 11.

Waste waters contain few compounds that individually have an adverse effect on WWTPs or receiving waters. Possible exceptions include:

- salt where large amounts are used, e.g. pickling and cheesemaking;
- pesticide residues not readily degraded during treatment;
- residues and by-products from the use of chemical disinfection techniques;
- some cleaning products.

Typical waste water treatment

For the treatment of waste water normally (a combination of) the following is applied:

- apply an initial screening of solids;
- remove fat using a fat trap (if applicable);
- apply flow and load equalization (highly biodegradable matter will degrade naturally when residence time of a day of more is applied, potentially halving the BOD);
- apply neutralization to strongly acid or alkaline waste water;
- apply sedimentation for waste water containing suspended solids;
- apply dissolved air flotation if additional floatation is required (also see section 2.3);
- apply biological treatment if this is cost effective regarding possible discharge fees.

3.3. Waste water treatment at mines

Mines generally generate two types of waste water:

- Mining water, to separate ore from the rock, to cool drills, to wash the ore during production, to carry away unwanted material and for site dust control;
- Domestic waste water originating from labour camps.

Typical waste water effluent

Mining water
Emissions to water originating from mining activities can include:

- Reagents like cyanide, xanthenes;
- Acids or bases resulting is low or high pH;
- Solid or dissolved metals or metal ferrous compounds (e.g. iron, zinc, aluminium);
- Dissolved salts e.g. NaCl, Ca(HCO3)2, etc;
- Radioactivity (in coal tailings/waste-rock heaps);
- Chloride (coal mines);
- Suspended solids (increasing turbidity).

Domestic waste water
The treatment of domestic waste water from labour camps is comparable to waste water treatment at medium sized urban centers (see paragraph 6.1.2).

Typical waste water treatment

First of all, significant effort must be put in the recycling of water and reagents (e.g. flotation reagents, cyanide, flocculants).

Certain reagents such as cyanide require long retention time, oxidation (air, bacteria, sunlight, and, for xanthates, temperatures above 30° Celsius to decompose. Therefore the planning of the mineral processing circuit must consider the environmental impacts of the substances and potential need for extra ponding or treatment to provide for certain reagents' decomposition.

Table 5 provides an overview of the effect of some metals on humans, animals and plants[2].

Table 5. Overview of the effect of some metals used in mining on humans, animals and plants

Metal	Effect
Arsenic (As)	Highly poisonous and possibly carcinogenic in humans. Arsenic poisoning can range from chronic to severe and may be cumulative and lethal
Cadmium (Cd)	Cadmium is concentrated in tissue and humans can be poisoned by contaminated food, especially fish. Cd may be linked to renal arterial hypertension and can cause violent nausea. Cd accumulates in liver and kidney tissue. It depresses growth of some crops and is accumulated in plant tissue
Chromium (Cr)	Cr^{+6} is toxic to humans and can induce skin sensitisations. Human tolerance of Cr^{+3} has not been determined
Lead (Pb)	A cumulative body poison in humans and live-stock. Humans may suffer acute or chronic toxicity. Young children are especially susceptible
Mercury (Hg)	Hg and its compounds are highly toxic, esp. to the developing nervous system. The toxicity to humans and other organisms depends on the chemical form, the amount, the pathways of exposure and the vulnerability of the persons exposed
Copper (Cu)	Small amounts are considered non-toxic and necessary for human metabolism. However, large doses may induce vomiting or liver damage. Toxic to fish and aquatic life at low levels
Iron (Fe)	Essentially non-toxic but causes taste problems in water
Manganese (Mn)	Affects water taste and may stain laundry. Toxic to animals at high concentrations
Zinc (Zn)	May affect water taste at high levels. Toxic to some plants and fish

2 Source: IPPC BAT document on management of tailings and waste-rock in mining activities.

During the operation and exploration of a mine it may become necessary to collect and treat the drainage before it reaches the environment. This treatment could be done either through passive treatment (e.g. wetlands or anoxic limestone drains) or through active treatment in a water treatment plant (straight liming, HDS-process, etc). At closure, it may be necessary to treat the drainage even after a cover has been put in place, until the impact of releasing the drainage to the environment can be regarded as acceptable.

Water treatment in general consists of precipitation of dissolved elements (mainly metals) and separation of precipitates and particles. For precipitation either sulphide or lime is applied. For separation the following technologies are applied:

- gravity or forced sedimentation, and/or;
- (sand or bag) filtration, or;
- membrane filtration.

The sludge obtained will require proper management and deposition. In the ideal case, it can be deposited as part of the back filling operation of the mine.

An example of a mining WWTP is given in Annex 10.

4. Waste water treatment facilities

4.1. Inventory

Waste water treatment in Mongolia typically consists of old Russian-designed independent plants which mainly aim at treating Carbon pollution. The plants in general are not designed to remove nutrients like nitrogen or phosphor. Most treatment plants discharge their treated effluent to a nearby river or to infiltration fields.

An overview of the WWTPs (waste water treatment plants) is given in Annex 2. In 2010 there were 115 WWTPs treating waste water of which 91 treat municipal and industrial water and 24 treat industrial waste water only. Most of the WWTPs are located in the central part of the country (Figure 10).

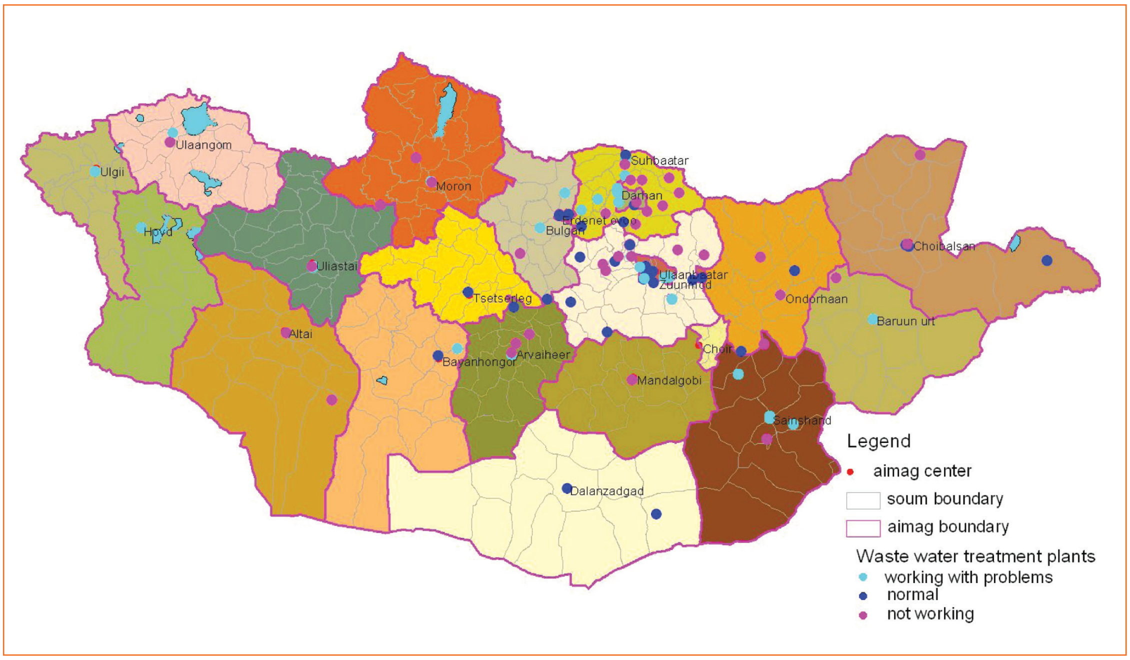


Figure 10. Location of waste water treatment plants (municipal and industrial, 2008)

Of the total number of WWTPs 38 are reported to be working, 36 are reported to be working abnormal and 41 are reported not working (Figure 11)[3]. Many WWTPs have fallen into disuse due to a lack of funds for the operation and maintenance. Also the equipment used is old and needs replacement.

[3] The number of working WWTPs is probably lower than indicated because many of the working WWTPs appeared not to be working during field inspections in 2009 and 2010.

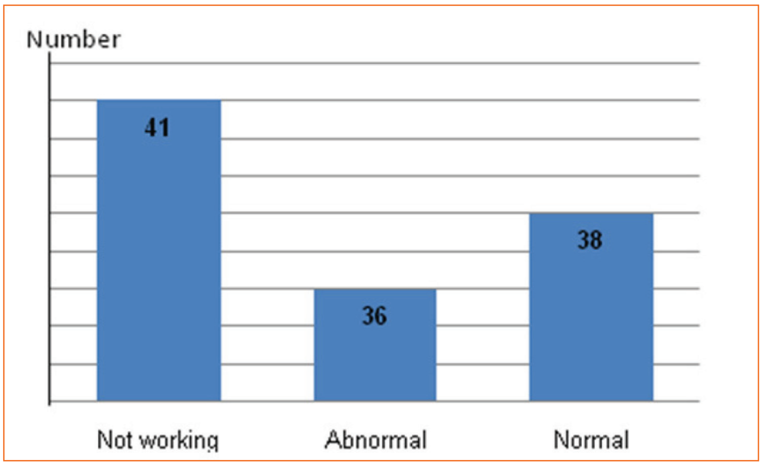


Figure 11. Number of waste water treatment plants (2008)

4.2. Municipal waste water treatment facilities

The capacity of the municipal WWTPs ranges from small plants treating a few hundred m^3/day to big plants treating 16,000 m^3/day (Darkhan) or 160,000 m^3/day (Ulaanbaatar). The capacity of the WWTPs in the aimags ranges generally between 1,000 - 5,000 m^3/day (Figure 12 and Figure 13).

The technologies used in the municipal WWTPs are generally a combination of mechanical and biological treatment consisting of aeration, sedimentation and chlorination (Table 6). The effluent water is discharged to a nearby river or to the soil. The sludge is transported to drying beds.

4.2.1. Current state of condition

Of the total number of municipal WWTPs 30% are reported to be working, 30% are reported to be working abnormal and 40% are reported not working (Figure 11)[4]. Many WWTPs have fallen into disuse due to a lack of funds for the operation and maintenance. Also the equipment used is old and needs replacement.

Table 6. Technologies of existing municipal waste water treatment plants (2008)

Design capacity (m^3/day)	Total number	Technology		Discharge	
		Type	Number	Type	Number
50 – 200	30	Mechanical	9	Soil	21
		Mechanical and biological	21	River	9
200 – 500	16	Mechanical	8		13
		Mechanical and biological	8	Soil	3
500 – 1,000	10	Mechanical	2	River	5
		Mechanical and biological	8		5
1,000 – 5,000	22	Mechanical	7	Soil	11
		Mechanical and biological	14	River	10
					1
		Chemical	1	Soil	
5,000 – 10,000	2	Mechanical	1	River, lake	2
		Mechanical and biological	1	Sewage line	

[4] The number of working WWTPs is probably lower than indicated because many of the working WWTPs appeared not to be working during field inspections in 2009 and 2010.

Design capacity (m^3/day)	Total number	Technology		Discharge	
		Type	Number	Type	Number
10,000 – 30,000	2	Mechanical and biological	2		2
30,000 – 100,000	1	Mechanical and biological, chemical	1	Soil	1
> 100,000	1	Mechanical	1		1
Unknown	7	Mechanical and biological	4	River	6
		Mechanical and biological	2 1	River	1

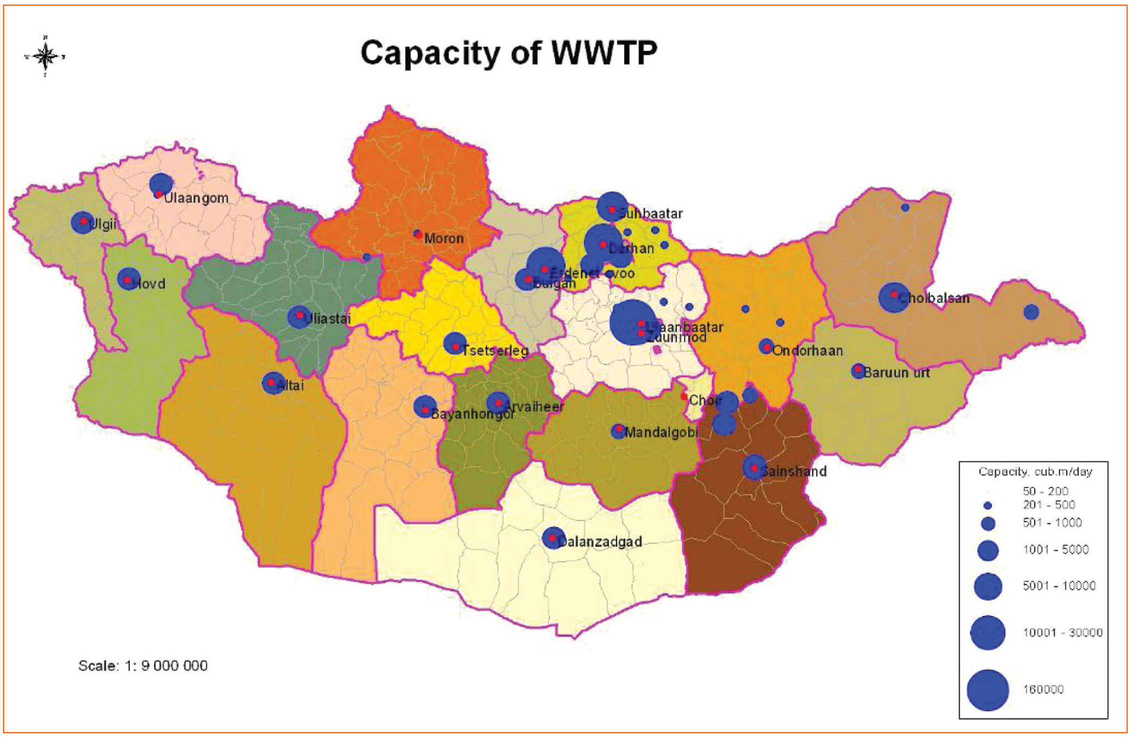


Figure 12. Location and capacity of municipal waste water treatment plants (2008)

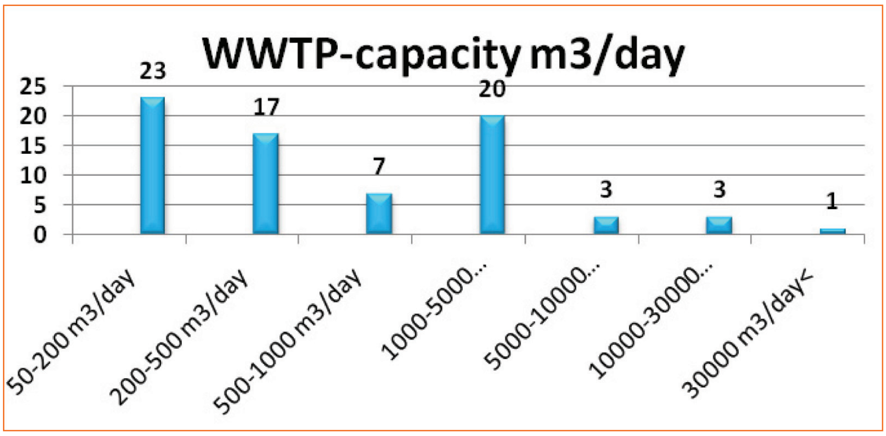


Figure 13. Capacity of working municipal waste water treatment plants (2008)

Treatment of waste water is done in most aimag centers but continued operation of these facilities has been difficult. At many locations the treatment facilities are not working and waste water is discharged untreated (e.g. at Gobi Altai and Arvakheer, Figure 14).

Figure 14. Waste water treatment plants in Gobi Altai (left) and Arvakheer (right) (2009)

In Ulaanbaatar USUG operates one central waste water treatment plant and 4 small waste water treatment plants. The central waste water treatment plant has a potential capacity to treat 230,000 m^3 of municipal and industrial waste water per day by means of mechanical and biological processes. In the current situation it treats about 160,000 - 170,000 m^3 waste water per day, since not all parts are well-functioning.

Figure 15. Waste water treatment plant in Ulaanbaatar City

In Darkhan the CWWTP is reported to be underutilized and the condition of various ponds has deteriorated (MoMo, 2009). The CWWTP utilized only a third of its capacity in 2009.

It may be concluded that the exploitation and technological regime of many plants is problematic. Judging from the information, most of the municipal WWTPs are not operating according to the designed requirements and the physical state of the infrastructures in general is poor. Most of the mechanical treatment facilities aren't operated in accordance with their technological regime and they are used just for transmitting waste waters.

Figure 16. Waste water treatment plant in Darkhan City (2009)

4.2.2. Level of municipal waste water treatment required

It is clear that improvements need to be made to the waste water treatment in Mongolia. In order to upgrade the level of treatment to an acceptable level, the required treatment may be separated in necessary treatment and optional treatment.

Necessary treatment:

- BOD/COD removal, because otherwise all oxygen will be consumed by the organic material leaving no oxygen left for fish, water animals and water plants;
- Ammonia removal, because this is direct toxic to e.g. livestock drinking this (surface) water.

Optional treatment:

- Nitrogen removal, because nitrogen will act as a nutrient for algae which again will consume all oxygen in water;
- Phosphate removal, because phosphate will act as a nutrient for algae which again will consume all oxygen;
- Disinfection, in order to guarantee a certain degree of hygiene downstream of the discharge point.

The design of the treatment facilities should use the requirements shown in Table 7. These requirements correspond with the concentrations specified in the effluent standard MNS 4943:2011 (Annex 1).

Table 7. Required effluent quality at the outlet of the WWTPs

Parameters	Units	Maximum concentrations allowed	Analyses frequency
BOD	mg/l	< 20	daily
Suspended solids	mg/l	< 35	daily
COD	mg /l	< 50	daily
N	mg/l	< 15[5]	daily
P	mg/l	< 5	daily

The order of magnitude of the required treatment capacity is linked to the level of water supply (Table 8). The level corresponds with different classes of population centers. The waste water treatment facilities are planned for each level (see chapter 6).

[5] Allowed concentration relevant only for WWTP serving more than 50,000 people

Table 8. Categories of general treatment capacities

nr	Level	Classification of treatment	Capacity	Population connected to sewage system
1	Ulaanbaatar	Very large WWTP	>200,000 m^3/day	> 300,000 people
2	Large cities (Darkhan, Erdenet)	Large WWTP	>10,000 m^3/day	> 50,000 people
3	Urban centres with private connections	Medium WWTP	>25 m^3/day	> 1,000 people
4	Urban centres with private connections	Small WWTP	≤ 25 m3/day	≤ 1,000 people
5	Urban centres without private connections	Public and private pit latrines	-	≤ 1,000 people
6	Ger areas	Private pit latrines	-	-
7	Rural areas	Private pit latrines	-	-
8	Ger camps	Compact treatment facilities or Public pit latrines	-	10 to 50 people

4.3. Industrial waste water treatment facilities

4.3.1. Inventory

Industrial waste water is treated by municipal WWTPs or by dedicated industrial WWTPs. Of the 115 waste water treatment plants (Figure 11), 24 treatment plants are working exclusively for producing industries (Figure 17).

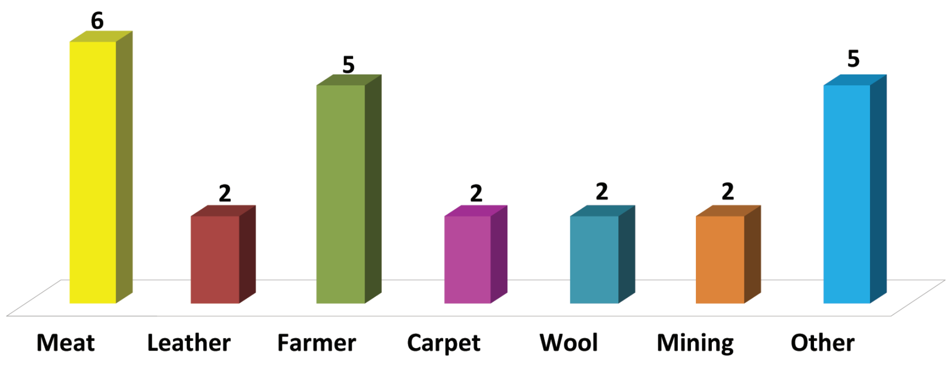


Figure 17. Number of industrial waste water treatment plants in Mongolia

The technologies used in the industrial WWTPs are generally a combination of mechanical and biological treatment consisting of aeration, sedimentation and chlorination (Table 9). The effluent water is discharged to municipal WWTP.

Table 9. Technologies used by industrial waste water treatment plants

Design capacity (m³/day)	Total number	Technology		Discharge	
		Type	Number	Type	Number
50 – 200	7	Mechanical	5	Soil	3
		Mechanical and biological	1	River	3
		Chemical	1	Sewage line	1
200 – 1,000	6	Mechanical	2	Soil	2
		Mechanical and biological	4	River	2
				Sewage line	2
1,000 – 10,000	7	Mechanical	6	Soil	1
			1	River	2
		Chemical	1	Sewage line	3
				Unknown	1
>10,000	2	Mechanical	2	Sewage line	2
Unknown	2	Mechanical and biological	1	Soil	1
			1	River	1

A survey in 2008 of the factories producing cashmere and leather showed that 31 leather and 42 cashmere producing factories are working in Ulaanbaatar. The effluent concentration is high which these factories discharge to the central treatment plant.

A survey at national level on the individuals, enterprises and organizations which have permission to use chemical substances showed that most industries with permission to use the substance are scientific, health protection or processing factories.

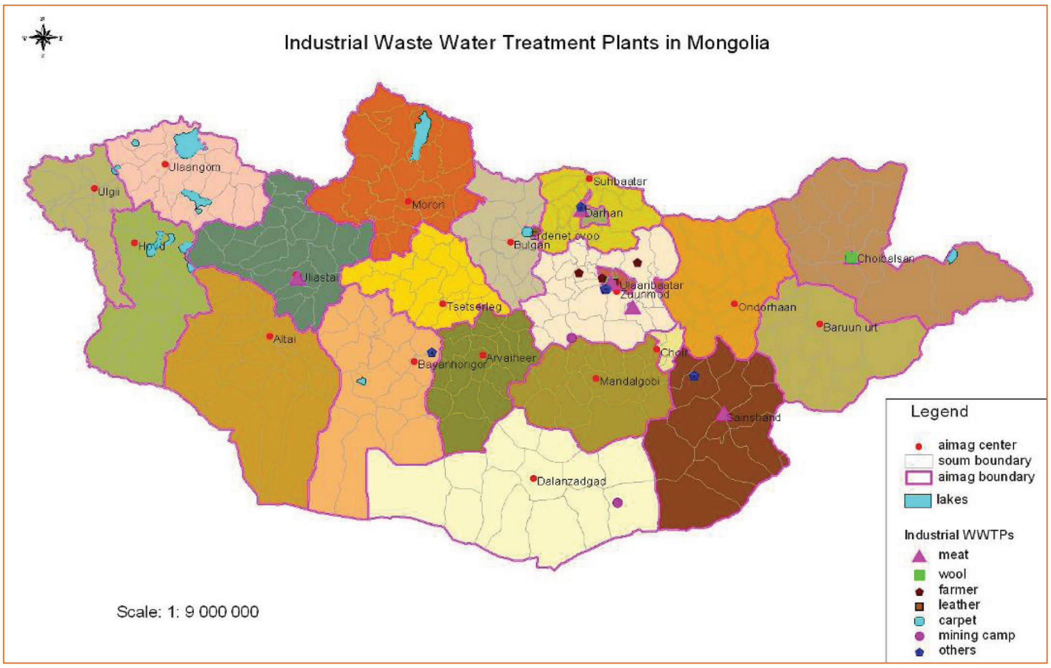


Figure 18. Location of industrial waste water treatment plants in Mongolia

Mongolian industries either directly dispatch their waste water into the sewer, treat the waste water on-site or dispatch the waste water to a dedicated industrial waste water treatment plant. The Khargia plant in Ulaanbaatar is an example of a dedicated industrial waste water treatment plant as it collects and treats the industrial effluent from approximately 20 industries (mainly tanneries). The plant has not been working since the 90s and is in a bad condition, but plans have been made to replace the facility with a new treatment plant.

Another dedicated industrial waste water treatment plant has been opened in 20... in Darkhan (name: Hanza) with one large tannery (production capacity of 1 million hides per year) connected.

Many industries however do not have treatment on-site or are not connected to a dedicated industrial waste water treatment plant. These industries often discharge the waste water to the central sewage system causing problems at the municipal waste water treatment plant, because the treatment processes at these plants are designed for domestic waste water and not for industrial waste water.

4.3.2. Level of Industrial waste water treatment required

Industrial effluent should be treated on-site before discharging the effluent for further treatment to a central municipal WWTP. The industries are to implement a certain level of effluent treatment or effluent conditioning to avoid treatment problems at the receiving municipal WWTP. The type of treatment required depends on the type of industry as already described in section 3.2.

5. Description of sanitation facilities in ger areas

5.1. Current situation

The need for basic sanitation services (i.e. drinking-water supply, excreta and waste water disposal) in urban areas has increased as a result of rapid population growth and higher expectations. In the areas not covered by the sewage network individuals are responsible for their own sanitation facilities.

The current practice for toilets in ger areas is the use of simple pit latrines, constructed by the inhabitants themselves and abandoned and closed usually after 4 to 5 years of use.

Drawbacks are:

- Pollution in terms of sanitary conditions, odour and the proliferation of flies
- In sensitive areas, risk of groundwater pollution
- Not sustainable on small land plots which will become unfit for any use after a few years.

In rural areas it is uncommon for nomadic families to have toilet facilities as they move from season to season. But more sedentary cattle raising families often have a pit latrine near their homestead.

In Ulaanbaatar it is estimated that over 100,000 pit latrines are located in the ger areas. According to an assessment completed in 2003, 59 percent of pit latrines and 54 percent of soak pits in the ger areas failed to meet the hygienic standard. About 14 percent and 34 percent respectively of the total households in the ger areas did not have a pit latrine or soak pit. The MoH estimates that soil contamination contributes to between 20-30 percent increased risk of infectious diseases, such as diarrhea and Hepatitis A. The conditions in the ger areas in rural Mongolia are not better. Most hospitals and schools located at soum centres use pit latrines only. Only 1.6 percent is connected to the sewage system (UNDP, 2009a).

The introduction and use of the lined double pit latrine for ger areas will be more effective to prevent soil and groundwater contamination and to decrease the need for digging new pits when the old one is filled.

Construction of Ventilated Improved Pit latrines with a lined pit is recognized by dwellers and local authorities as a means for shifting to improved access to sanitation in ger areas. Some of these facilities can already be found throughout Mongolia, usually as a result of donor funded projects (UNDP, 2004).

Maintenance is pit emptying and its frequency is estimated to be around 4/5 years for a family sized VIP latrine. Progressive conversion from traditional to VIP latrines implies the phasing-in of a pit emptying service with trucks. Considering the standards of living of families in ger areas, it appears that the emptying cost cannot be borne by inhabitants without sponsorship of some kind, even if the emptying of the latrine makes it unnecessary to rebuild a new one.

Ger areas would not be the only ones to call for such a service. This could be applied to any area, water connected or not, using dry toilets or septic tanks. This will generate quantities of sludge that will need to be disposed of, but, being normally safe from pollutants like heavy metals, this will be fit for agricultural recycling (Seureca, 2006).

5.2. Low cost sanitation technologies for ger areas

The Manual on Low Cost Sanitation Technologies for Ger Areas, Mongolia (City of Ulaanbaatar, 2006) describes the various latrine options, the advantages, disadvantages, building materials, bill of materials, costs, salient features and so on, for participatory bottom up planning and implementation of the sanitation improved services. It starts with no hardware investment to gradually improved latrine types like a 'sanitation ladder'.

In a workshop in 2005 the hygiene and sanitation sector professionals in Mongolia defined sanitation as means of collecting and disposing of excreta and community liquid waste in a hygienic way so as not to endanger the health of individuals or the community as a whole. The 'sanitation informed choice' is defined as a pre-selected set of latrine options that are locally suitable, culturally acceptable and economically affordable for the improvement of low cost sanitation services.

Latrine options suitable for immediate application in ger areas were selected by hygiene and sanitation sector professionals through a series of consultations in a process referred to as "sanitation informed choice." The criteria that were adopted for selecting 'sanitation informed choice for Ger areas' are:

- Effective use: Cultural acceptability and ablution habits of the users.
- Water availability: Availability of water for ablution or cleaning/washing.
- Technical feasibility: Climatic situation of the target area and situation of existing groundwater table.
- Affordability: Capital and maintenance costs of latrines.
- Upgradability: Working life and up-gradation possibilities.
- Supply chain: Availability of building materials at local level.
- Local Technical support: Availability of local technical resources – the 'critical mass' to promote and support construction of different kinds of latrines.

6. Planning of municipal waste water treatment facilities

6.1. Planning of municipal waste water treatment plants

The planning of the municipal WWTPs is based on the categories presented in *Table 8* and the technologies described in paragraph 3.1. For each category a proposal is made on the desired treatment technology. An overview of the proposed technologies is presented in Annex 3. The proposed technologies are described in the following paragraphs including a cost estimate.

A new municipal WWTP usually is designed for a 15-20 year plan horizon, which means new facilities are to be planned for the year 2030.

6.1.1. Planning of very large and large municipal waste water treatment plants

The large municipal WWTPs are planned at Ulaanbaatar (very large), Erdenet and Darkhan. The required capacity of the facilities are >200,000 m^3/day at Ulaanbaatar and >10,000 m^3/day at Darkhan and Erdenet. These capacities are sufficient to cover the waste water treatment demand until the year 2030.

The options for renewal of municipal waste water treatment plants (as described in paragraph 4.2.2) should include ammonia removal, COD removal and disinfection and could include nitrogen removal and/or phosphate removal. The treatment options result in different designs and investment costs.

The following general treatment set-up for very large and large municipal WWTPs is suggested:

- Raw water tanks fitted with pumps and screening units;
- Primary sedimentation tanks;
- Aeration tanks, biological activated sludge treatment;
- Secondary sedimentation;
- Disinfection with chloride in contact tank.

Table 10. General design parameters of large treatment facilities

	COD	BOD	Nitrogen	Total Nitrogen (TN)	Total Phosphorous (TP)	Suspended Solids
Water quality effluent standard MNS 4943:2011 (mg/l)	50	20	15.0	15 (suggested)	1.5	50
TEMPERATURES						
Minimum	°C	7	Minimum for nitrification is 8 °C			
Design	°C	10	Design solid retention time (SRT)			
Average	°C	15	Calculation of sludge production			
Maximum	°C	20	Design of aeration			

For sludge treatment the following set-up is suggested:

- Thickening
- Natural dewatering using sludge drying beds with optional mechanical dewatering using sludge press.

Ulaanbaatar

Many studies have been carried out in the recent past in order to determine the required upgrades and extensions of the different municipal WWTPs in Ulaanbaatar in future. The WWTPs which are situated in Ulaanbaatar are (from large to small) Central, New City Centre, Yarmag, Bagakhangai, Airport, Bayanzurkh, Nairamdal and Biokombinat.

USUG estimated the sewage loads and discharge (see Table 11) based on projected municipal and industrial waste water treatment in 2030.

Table 11. Basic design assumptions Ulaanbaatar waste water treatment facilities

	Central	Nisekh/ Yarmag	New City Center	Gorodok	Biokombinat
COD (kg/d)	248,000	7,560	6,300	2,400	204
BOD (kg/d)	118,000	3,780	3,150	1,200	102
Nkj-N (kg/d)	21,300	740	620	230	20
Ptot-P (kg/d)	3,960	137	110	43	4
TSS (kg/d)	132,000	4,095	3,410	1,300	111
Cr (kg/d)	311	<1	<1	<1	<1
Discharge (m^3/d)	248,000 –380,000	9,500 – 14,500	7,900 – 12,100	3,000 – 4,600	255 - 400

Source: USUG, 2010

Erdenet and Darkhan

The treatment options of the two main cities outside Ulaanbaatar are shown in Table 12.

Table 12. Treatment options Erdenet and Darkhan waste water treatment facilities

Option	Necessary	Optional
1	Ammonia removal (nitrification) COD removal	Disinfection
2	Ammonia removal (nitrification) COD removal	Nitrogen removal (de-nitrification) Disinfection
3	Ammonia removal (nitrification) COD removal	Phosphate removal (chemical P removal) Disinfection
4	Ammonia removal (nitrification) COD removal	Nitrogen removal (de-nitrification) Phosphate removal (chemical P removal) Disinfection

Using the design assumptions shown in Table 13 and Table 14 preliminary designs are prepared for the Erdenet and Darkhan waste water treatment facilities.

Table 13. Basic design assumptions Erdenet waste water treatment facilities

Waste water forecast Erdenet	2030
Water use ltr/day/person centralized system (apartments)*	130
Percentage of population connected to centralized system*	72.5%
Population living in Erdenet	82,137
Population discharging on WWTP	59,549
Waste water forecast (m^3/year)	2,825,615
Waste water forecast (m^3/day)	7,741
Industrial discharges (m^3/day)	N/A
Discharges from institutes (m^3/day)	N/A
Base hydraulic load (m^3/day)	7,741
Total hydraulic load (m^3/day) (1.5 times base hydraulic load)	11,612
DWF (m^3/h) (total hydraulic load divided by 10)	1,161
RWF (m^3/h) (DWF times 2)	2,322

**) Source: MDG-based comprehensive National Development Strategy Objectives*

Table 14. Basic design assumptions Darkhan waste water treatment facilities

Waste water forecast Darkhan	2030
Water use ltr/day/person centralized system (apartments)*	130
Percentage of population connected to centralized system*	72.5%
Population living in Darkhan	73,783
Population discharging on WWTP	53,493
Waste water forecast (m^3/year)	2,538,227
Waste water forecast (m^3/day)	6,954
Industrial discharges (m^3/day)	N/A
Discharges from institutes (m^3/day)	N/A
Base hydraulic load (m^3/day)	6,954
Total hydraulic load (m^3/day) (1.5 times base hydraulic load)	10,431
DWF (m^3/h) (total hydraulic load divided by 10)	1,043
RWF (m^3/h) (DWF times 2)	2,086

*) *Source: MDG-based comprehensive National Development Strategy Objectives*

6.1.2. Planning of medium municipal waste water treatment plants

The design of medium size municipal WWTPs for urban centres with 1,000-50,000 people deviates from the design of large WWTPs because:

- the Aimags and Soums operating the plants have limited financial means and therefore require cost efficient technologies with low operational costs;
- at some locations continuous power supply is not available or not reliable; therefore energy requiring technologies like aeration can be considered only if power supply is continuous;
- lower effluent temperatures may be expected in case warm water supply is not available; extra heating is expected to occur from aeration only;
- it is expected at many locations that effluent temperatures will be ≤8 ˚C at most times during the year; therefore nitrification is not expected to occur as the minimum for nitrification is 8 ˚C;
- a continuous supply of chemicals is uncertain, both because of cost and logistic perspective.

Considering the above considerations the basic design of the medium municipal WWTPs consists of:

- if possible a gravitational system, to avoid the use of sewage pump pits (depending on available slopes and elevations);
- technology is focused on BOD/COD removal;
- ammonia removal is not included as nitrification is not expected to occur (perhaps in summer some nitrification will occur to a certain extent);
- nitrogen removal (de-nitrification) is not included as nitrification is not included either;
- chemical phosphate removal is not included as this requires a lot of chemicals; biological phosphate removal is considered to be too complex and too instable;
- aeration is included only if continuous power supply is guaranteed;
- Disinfection is not included as it requires either power supply or chemicals.

Therefore, the following treatment set-up options for Mongolian medium municipal WWTPs are suggested:

1. With continuous power supply:
    - Raw water tank(s) fitted with pumps and screening units;
    - Primary sedimentation tank(s);
    - Aeration tank(s), biological activated sludge treatment;
    - Secondary sedimentation;
    - Disinfection with chloride in contact tank.
2. Without continuous power supply:
    - Influent receiving tank, which can be closed for maintenance;
    - Primary sedimentation tank(s);
    - Secondary sedimentation tank(s);
    - additional sand/gravel filter (when groundwater tables are too high for direct soil infiltration);

For sludge treatment the following set-up is suggested:

- Natural dewatering using sludge drying beds.

The option without aeration should be designed such that in future it can be extended with an aeration system, increasing the COD reduction rate. The option without aeration requires limited maintenance and has low operational costs. The sludge is pumped from the sedimentation tank(s) to the drying beds by fixed or mobile sludge pumps. In the absence of industries no pollutants which could harm the environment or groundwater quality are expected to exist in the sludge or the infiltrated effluent.

6.1.3. Planning of small municipal waste water treatment plants

The design of small size municipal WWTPs for centres with less than 1,000 people includes:

- Effluent receiving pit, which can be closed for maintenance;
- Three compartment tank, existing of:
    - first compartment: primary sedimentation;
    - second compartment: secondary sedimentation (option to include aeration if electricity supply is guaranteed);
    - third compartment: final sedimentation;
- additional sand/gravel filter when groundwater tables are too high for proper direct soil infiltration;
- discharge to infiltration pond (soil infiltration which is allowed according to standard MNS4943 as long as capacity is ≤ 25 m3/day, making disinfection redundant).

The system should be designed such that in future it can be extended with an aeration system, increasing the COD reduction rate. The option without aeration requires limited maintenance and has low operational costs. Sludge needs to be drained one or two times a year by means of a submersible drain pump. The sludge can be spread out somewhere at a dedicated suitable place where it can dry and degrade by natural processes.

In most cases in small communities at the moment no water supply or waste water treatment is available. Once it is decided to improve the sanitary and health situation and to construct piped water supplies, automatically waste water collection and treatment is required. Therefore water supply and waste water collection and treatment should be constructed within one and the same project (and budget).

A typical water supply and waste water treatment system for a small community of 500-1,000 people consists of:

Water supply system, consisting of:

- one borehole;
- pump station with pumping building;
- pump station;
  - piping network distributes the water to one or more kiosks, public connections such as schools (with or without dormitory), hospitals, and public buildings;
  - sanitary room in each of the supplied building (toilets, water taps, sinks, showers) to connect both the water supply and sewage on, as these facilities are not yet present in most of the buildings;
  - water storage tank in each of the supplied building;

Waste water treatment collection and treatment, consisting of:

- Sewage network 800 to 1,500 meters (HDPE);
- Waste water pump station (requirement depending on local slope and elevation);
- WWTP concrete structure (including effluent receiving pit, three compartment tank, optional sand/gravel filter);
- Infiltration pond.

Such a combined water supply and sewage system is proposed in a UNDP supported water and sanitation project for four soums in Gobi Altai and Khovd (UNDP, 2009).

Compact treatment facility, package units

For remote areas where no connection to a nearby municipal WWTP is possible and where a considerable amount of waste water is produced (10 to 50 people) it is proposed to apply a septic tank with a septic drain field. Typical applications include ger-camps, hotels situated in remote areas, small labour camps, independent houses etc.

A septic tank generally consists of one or more tanks connected to an inlet waste water pipe at one end and a septic drain field at the other (see Annex 6).

The investment costs for a septic system range from 18,000,000 Tugrug (1-5 people) to 42,000,000 Tugrug (50 people). More information about technologies of septic systems is found in Annex 6.

6.2. Public and private dry sanitation

Public pit latrines can be applied to improve the sanitary situation in cases where hardly any financial means are available to organize total waste water collection at once (e.g. in ger areas) and/or in cases where no frequent usage of the facilities is to be expected.

Preventive and hygienic behavioral measures at pit latrines will help to reduce the transmittance of infectious diseases:

- The squatting plate needs to be cleaned daily. Unclean squatting plate can be a source for spreading pathogenic bacteria and diseases.

- Soakage pits pose a risk to health where there is an inadequate separation between the pit and the groundwater table. Under these circumstances, pathogens may contaminate water supply in the vicinity. However, where the pit is well above the groundwater table, water may be safely abstracted from a well or borehole a few meters away from a latrine.
- A ventilated latrine eliminating the chances of flies coming in direct contact with excreta. This prevents fly-borne transmission of fecal-oral diseases from latrines, a major source of disease transmission.
- Hand washing after each toilet visit.

6.3. Planning of sewage collection networks

The plans of the Mongolian Government (MDG-based comprehensive National Development Strategy Objectives) imply an increase in waste water towards the year 2030 due to increasing numbers of population connected to the sewer. This implies the need to expand the sewage collection networks nationwide.

In the large cities the main sewer networks include pipes from diameter 200 mm to 1400 mm. The current practice (in Ulaanbaatar) is to use cast iron pipes for small diameters (200 to 400 mm) and concrete pipes for the larger ones (500 to 1400 mm) for planned network extensions.

The piping lengths in large and medium size cities are presented in Annex 5. For the determination of piping cost estimates for large cities the presented figures can be used. For the medium sized cities another more pragmatic method is used by determining a key figure of the required length of sewage pipes per inhabitant, based on the total sewage network lengths for different medium size cities (Table 15).

As expected, the key figures highly depend on the building density of a city. The building density of medium sized cities is low but the figure is relatively high because of the presence of apartment blocks with 4-6 floors. Therefore it is proposed to apply the following for medium sized cities:

- 1.0 mtr/capita as an average key figure for a typical sewage piping length;
- 0.8 mtr/capita as an average key figure for a typical drinking water piping length[6].

6.4. Investment and operational costs waste water treatment plants and sewage collection networks

The investment and operational costs were estimated based on the designs described above. The calculated costs are indicative and should not be used for budgeting. For more precise calculations a preliminary and detailed design must be prepared together with detailed cost estimates for each specific situation.

The cost estimates are prepared for a 20-year plan horizon. Waste water volumes are based on the estimated size of the population in the year 2030. The calculation results are presented in Annex 8.

[6] Drinking water piping length in Mongolia is longer compared to sewage piping length because water supply to ger areas via kiosks is included, where normally ger areas are not connected to sewage networks.

6.4.1. Very large municipal WWTP

In Ulaanbaatar cost estimates made in the past for the upgrade and extension of the central WWTP (by far the largest WWTP in Mongolia) range from 140 million dollar (modern and efficient waste water treatment with a full Nitrogen treatment capacity; SEURECA, 2006) to 400 million dollar (biological nitrogen and phosphate removal; USUG, 2010).

Table 15. Length of pipelines sewage and drinking water networks (2008)

No	Name	Inhabitants	Sewage kms		Drinking water kms	
		Estimate 2006	Total (km)	Key figure mtr/ capita	Total (km)	Key figure mtr/ capita
1	Ulaanbaatar	862,842	146	0.17	350	0.41
2	Erdenet	82,137	40	0.49	260	3.17
3	Darkhan	73,783	223.6	3.03	215.3	2.92
4	Choibalsan	44,880	20.8	0.46	47.8	1.07
5	Olgii	30,483	17	0.56	20	0.66
6	Sainshand	29,386	54.2	1.84	10.5	0.36
7	Ulaangom	28,434	7.4	0.26	7.9	0.28
8	Khovd	28,301	18.3	0.65	18.2	0.64
9	Moron	28,117	6.9	0.25	5.3	0.19
10	Uliastai	26,493	12.2	0.46	11.3	0.43
11	Sukhbaatar	24,622	26.4	1.07	35.5	1.44
12	Bayankhongor	23,456	10.8	0.46	11.5	0.49
13	Arvakheer	20,940	7.7	0.37	7.6	0.36
14	Tsetserleg	19,305	18.3	0.95	10.3	0.53
15	Zuunkharaa	19,093	Missing information			
16	Altai	18,908	10	0.53	14.7	0.78
17	Zuunmod	18,048	22	1.22	23	1.27
18	Bulgan	17,564	2	0.11	8.5	0.48
19	Nalaikh	17,026	14	0.82	7.6	0.45
20	Baruun-Urt	15,930	10.4	0.65	28.4	1.78
21	Mandalgovi	15,608	5	0.32	80	5.13
22	Dalanzadgad	15,269	12.8	0.84	24.7	1.62
23	Undurkhaan	14,837	14.2	0.96	18.6	1.25
24	Choir	10,085	7.8	0.77	5	0.50
25	Tosontsengel	9,532	No sewage and drinking water network			

Source: Aimag offices

The cost estimates for the upgrade and extension of the medium and small sized WWTPs in Ulaanbaatar range from 9.5 million dollar (New City Center) to 0.2 million dollar (Biokombinat).

Variants to centralize the WWTPs are also studied, abandoning some of the existing small WWTPs and transporting the waste water to a restricted number of large WWTPs.

6.4.1. Large municipal WWTP

The costs for the large municipal WWTPs in Erdenet and Darkhan are calculated using a cost model developed by the project. The construction costs are determined based on expert judgement and in general are ten times lower compared to construction costs in Europe.

Excluded from the indicative cost estimates are:

- costs of effluent disinfection
- V.A.T.;
- Purchase of building ground;
- Final sludge digestion or treatment (end destination for landfill or fertilizer);

Sewage networks (will be elaborated in paragraph 6.3).

Table 16. Treatment options Erdenet waste water treatment facilities

Option	Capital expenditure	Operational expenditure	Per person
1	$ 10,990,200	$ 2,337,400	Investment: $ 115 Exploitation: $ 24 / year
2	$ 11,315,200	$ 2,389,400	Investment: $ 118 Exploitation: $ 25 / year
3	$ 11,107,200	$ 2,389,400	Investment: $ 116 Exploitation: $ 25 / year
4	$ 11,507,600	$ 2,449,200	Investment: $ 120 Exploitation: $ 26 / year

Note: The capital expenditure and operational expenditure costs exclude the costs of disinfection.

Table 17. Treatment options Darkhan waste water treatment facilities

Option	Capital expenditure	Operational expenditure	Per person
1	$ 10,351,900	$ 2,190,500	Investment: $ 120 Exploitation: $ 25.5 / year
2	$ 10,657,400	$ 2,230,800	Investment: $ 124 Exploitation: $ 26 / year
3	$ 10,454,600	$ 2,236,000	Investment: $ 122 Exploitation: $ 26.0 / year
4	$ 10,823,800	$ 2,291,900	Investment: $ 126 Exploitation: $ 26.77 / year

Note: The capital expenditure and operational expenditure costs exclude the costs of disinfection.

6.4.2. Medium municipal WWTP

It is common practice to use unit costs to prepare budgets for infrastructural construction projects. These unit costs are based on budgets of finalized projects. The average unit costs of treatment plants and waste water pipelines are presented in Table 18.

The average costs provide all-in costs, meaning that excavation, labour, installation etc. is included.

Table 18. Unit costs applied in Mongolia for medium municipal WWTP

Construction type	Unit	Unit cost
Waste water pipeline	1m	80 USD
WWTP	1 m^3/ day	2500 USD

These unit costs were used for medium sized urban centres with more than 10,000 people by estimating:

- what is the expected water use per day per capita;
- how many people are expected to connect to the sewage network;

- what is the expected length of the sewage piping required.

The calculation results and total costs are presented in Annex 8. The total costs range from 2.7 million dollar for Sukhbaatar city in Selenge aimag to 12.5 million dollar for Nalaikh. These costs take into account the state of the WWTP and the sewage line.

The state of the waste water treatment plants is used to estimate the investment costs of construction, upgrading or extension of the municipal WWTPs and the sewage networks. As an assumption for the determination of absolute investment costs a percentage is used of the total investment costs depending on the state of the waste water treatment plant.

Table 19. Determination of upgrade and extension costs of waste water treatment plants and sewage collection networks

State of condition WWTP	Upgrade and extension costs as % of construction costs of new WWTP		Upgrade costs as % of construction costs of new sewage network	
Not working	100%	new WWTP to be constructed	100%	new sewage network to be constructed
Abnormal	80%	for upgrade and extension of the current WWTP	60%	for upgrade of the current sewage network
Normal	30%	for extension of the current WWTP	10%	for maintenance of the current sewage network

For the sewage networks, it is assumed that the state of condition of the sewage network equals the state of condition of the related municipal WWTP. Therefore, for the upgrade of sewage networks the same methodology is used.

6.4.4. Small municipal WWTP

The total construction costs for a combined water supply and waste water treatment system for a small urban centre holding 500-1,000 people range from 500,000,000 to 625,000,000 Tugrug.

The elements of a small municipal WWTP are:

- Waste water pump station ranging from 30,000,000 to 40,000,000 Tugrug (requirement depending on local slope and elevation);
- WWTP concrete structure (including effluent receiving pit, three compartment tank, optional sand/gravel filter) ranging from 55,000,000 to 80,000,000 Tugrug.

6.5. Public pit latrines

The costs of public pit latrines can be derived from the report "Manual on Low Cost Sanitation Technologies for Ger Areas, Mongolia 2006". The cost estimates show a range of investment costs between US$ 90 (ventilated improved single pit latrine) to US$255 (ventilated improved double pit latrine).

The maintenance costs are negligible with a maximum of US$2-10 per year for replacement of fly-screen and trap (if necessary) and squat plate maintenance.

7. Planning of industrial waste water treatment facilities

7.1. Planning of facilities

The treatment of industrial waste water intends to treat the industrial effluent on-site or nearby the industry before discharging the water or transporting the effluent for further treatment to a central municipal WWTP. It is important that industries are forced to treat their waste water to ensure that they take care of their waste water themselves. This can be done by legal regulations and also by financial incentives.

The treatment of industrial waste water is technology specific and depends on the waste water effluent. The required technologies for on-site industrial waste water treatment are already described in section 3.2. Such treatment can be organized by an individual industry or collectively by a group of industries, such as tanneries.

No attempt was made to make an inventory of the industries requiring waste water treatment. The scope of the project did not allow for such a labour intensive inventory.

7.2. Investment and operational costs industrial waste water treatment plants

A cost estimate and construction planning has been prepared by a commercial company for the upgrade and extension of the Khargia WWTP. Annex 9 shows the cost estimate and design. The total estimated costs for the plant are 1,740 million tugrugs for renovation and 13,750 million tugrugs for constructing a mechanical sieve and a bio-membrane reactor.

Costs for the technologies described in section 3.2. are not available.

8. Recommendations related to WWTPs and sanitation

- Improve private and public sanitation to adjust to hygienic requirements
- Take measures to improve waste water treatment and sanitizing systems by improving water supply by constructing private connections
- Improve monitoring of the treatment level of municipal WWTP's to ensure normal operation of WWTP's
- Improve and renew WWTP's equipments, stabilize operation and monitoring of treated waste water
- Make amendments in the law to require companies which produce industrial waste water to construct waste water treatment facilities according to standard, which have no ecological negative impacts, provide labor safety and meet hygienic standard requirements.
- Treat WWTP sludge by compacting using filter press technology to use it for farming, for gas and electricity production and for construction purposes.
- Introduce technology to store in ponds and to reuse WWTP treated water.
- Develop general technical requirements, standard and guidance for using septic tanks and low capacity WWTPs that treat municipal waste water
- Link and connect ger district areas to waste water pipelines
- Develop technological solution of small scale waste water treatment suitable for households, organizations, soums and settled areas, suitable for Mongolian environment and weather conditions.
- Select and use according to the technical requirements imported sanitation technologies in relation to the above mentioned conditions.

9. References

1. Manual on Low Cost Sanitation Technologies for Ger Areas, Mongolia 2006
2. Seureca, 2006, Ulaanbaatar Water and Wastewater Master Plan
3. UNDP, 2004, Access to water and sanitation services in Mongolia
4. UNDP, 2009, Rural Water Supply and Sanitation in Mongolia
5. UNDP, 2009b, Feasibility Study for indoor Water Supply Sewerage Pipeline System and Wastewater Treatment Options in Public Buildings of the Project Target areas, MON/08/302
6. USUG, June 2010, Mission report Hans Schepman (in Dutch)
7. Ts.Tsatsral, B.Munkhbayr, J.Davaatseren "Independent Water Supply and Sanitation Facility", 2011.
8. Twan van der Mierde, "Waste Water Treatment and Rural Sanitation" Mission report IWRM, 2009

Annex 1. Standard for treated waste water to discharge into environment: MNS 4943:2011

Allowed upper concentration and limit of effluent treated wastewater and other indicators limit

No	Parameters	Үзүүлэлтийн нэр	Measuring unit	Allowed upper concentration and limit
1	Temperature	Усны температур	°C	20
2	Potential of Hydrogen, pH	Устөрөгчийн ионы илтгэгч, pH	-	6-9
3	Odour	Үнэр	*feeling*	no odour
4	Suspended solids	Жинлэгдэх бодис (умбуур)	*mg/l*	50
5	Biological oxygen demand (BOD_5)	Биохимийн хэрэгцээт хүчилтөрөгч ($БХХ_5$)	*mgO/l*	20
6	Chemical oxygen demand (COD)	Химийн хэрэгцээт хүчилтөрөгч (ХХХ)	*mgO/l*	50
7	Permanganate index	Перманганатын исэлдэх чанар (ПИЧ)	*mgO/l*	20
8	Dissolved salt	Уусcан давс	*mg/l*	1000*
9	Ammonium (NH_4)	Аммонийн азот (NH_4)	*mgN/l*	6
10	Total nitrogen (TN)	Нийт азот (TN)	*mg/l*	15**
11	Total phosphorus (TP)	Нийт фосфор (TP)	*mg/l*	1.5**
12	Organic phosphorus (DOP)	Органик фосфор (DOP)	*mg/l*	0.2
13	Hydrogen sulfide (H_2S)	Хүхэрт устөрөгч (H_2S)	*mg/l*	0.5
14	Total iron (Fe)	Нийт төмөр (Fe)	*mg/l*	1
15	Aluminum (Al)	Хөнгөн цагаан (Al)	*mg/l*	0.5
16	Manganese (Mn)	Манган (Mn)	*mg/l*	0.5
17	Toatal chromium (Cr)	Нийт хром (Cr)	*mg/l*	0.3
18	Chromium (Cr^{6+})	6 валенттай хром (Cr^{6+})	*mg/l*	none detected
19	Total cyanide (CN)	Нийт цианид (CN)	*mg/l*	0.05
20	Free cyanide	Чөлөөт цианид	*mg/l*	0.005
21	Copper	Зэс (Cu)	*mg/l*	0.3
22	Bor (B)	Бор (B)	*mg/l*	0.3
23	Lead (Pb)	Хар тугалга (Pb)	*mg/l*	0.1
24	Zinc (Zn)	Цайр (Zn)	*mg/l*	1
25	Cadmium (Cd)	Кадмий (Cd)	*mg/l*	0.03
26	Antimony (Sb)	Цагаан тугалга (Sb)	*mg/l*	0.05
27	Mercury (Hg)	Мөнгөн ус (Hg)	*mg/l*	0.001
28	Molybdenum (Mo)	Молибден (Mo)	*mg/l*	0.5
29	Toatal arsenic (As)	Нийт хүнцэл (As)	*mg/l*	0.01
30	Nickel (Ni)	Никель (Ni)	*mg/l*	0.2
31	Selenium (Se)	Селен (Se)	*mg/l*	0.02
32	Beryllium (Be)	Бериллий (Be)	*mg/l*	0.001
33	Cobalt (Co)	Кобальт (Co)	*mg/l*	0.02
34	Barium (Ba)	Бари (Ba)	*mg/l*	1.5
35	Strontium (Sr)	Стронци (Sr)	*mg/l*	2
36	Vanadium (V)	Ванадий (V)	*mg/l*	0.1
37	Uranium (U)	Уран (U)	*mg/l*	0.05
38	Mineral oil	Эрдэс тос	*mg/l*	1
39	Fat oil	Өөх тос	*mg/l*	5
40	Surfactants	Гадаргуугийн идэвхт нийлэг бодисууд (ГИНБ)	*mg/l*	2.5
41	Phenol (C_6H_5OH)	Фенол (C_6H_5OH)	*mg/l*	0.05
42	Trichloroethylene	Трихлорэтилен	*mg/l*	0.2
43	Tetrachloroethylene	Тетрахлорэтилен	*mg/l*	0.1

No	Parameters	Үзүүлэлтийн нэр	Measuring unit	Allowed upper concentration and limit
44	Chlorine, free	Үлдэгдэл хлор (Cl)	*mg/l*	1
45	Salmonella	Гэдэсний бүлгийн эмгэг төрөгч нян	*mg/l*	none detected in 1 mg

Remarks: **depending on the mineralization of the natural water: in case the mineralization is higher than the standard, then discharging effluent water should not increase the mineralizarion by more than 20 percent of the natural content. In case the mineralization is below the standard then discharging effluent water should not incraese the mineralization by more than 3 times.*

***the indicator should be decreased 5 times when discharging treated waste water into lakes, reservoirs and their affluent rivers.*

Annex 2. Overview Waste Water Treatment Plants (WWTP) in Mongolia 2008

№	Aimag and city	District and soum	Name of WWTP	Entered date	Category of cleaning	Capacity, m^3/day		Discharge place	Ownership status	Name of ownership	Now working	Reason of not working
						Design	Current					
1	Arkhangai	Tsetserleg city	Tsetserleg	1991	Mechanic	2700	2000	soil	Private	Undarga co., ltd	yes	Normal
2	Bayankhongor	Shargaljuut, mineral water	Shargaljuut, mineral water	1986	Biological	200	140	shargaljuut river	Private	Shargaljuut co.,ltd	yes	abnormal
3	Bayankhongor	Bayankhongor	Bayankhongor	1995	Biological	3000	1800	river Tui	Private	Chandmani baynkhongor co.,ltd	yes	Normal
4	Bayan-Ulgii	Ulgii city	Ulgii	1986	Biological Mechanic	2700	1800	river Khovd	Private	SUAT co.ltd	yes	abnormal
5	Bulgan	Rashaant soum	Rashaant soum	1986	Biological	200	132	soil		Soum Governor	yes	Normal
6	Bulgan	Bulgan city	Bulgan	1989	Mechanic	1200	1070	Zuun turuu river	Private	Bulgan meej co.,ltd	yes	abnormal
7	Bulgan	Khyalgant village	Khayalgant	1981	Biological	200	140	Selenge river	State	Soum Governor	yes	abnormal
8	Bulgan	Bayannuur soum	Bayannuur	1978	Nature, biological	100		soil	State	Soum Governor	No	not working
9	Bulgan	Mogod	Mogod	1971	Biological	100	80	soil	State	Soum Governor	No	not working
10	Darkhan-Uul	Darkhan soum	Darkhan	1965	Mechanic	50000	16000	Kharaa river	Private	Darkhan USUG	yes	Normal
11	Darkhan-Uul	Shariin gol	WWTP	1983	Biological	3500	1800	Shariin gol	Private	DSHG co.ltd	yes	Normal
12	Darkhan-Uul	Darkhan soum	Leather	1972	Mechanic	3500	1500	Kharaa river	Private	Darkhan nekhii co.,ltd	yes	abnormal
13	Darkhan-Uul	Darkhan soum	meat processing	1987	Mechanic	1800	1600	Kharaa river	Private	Makh combinat	yes	abnormal
14	Darkhan-Uul	Darkhan soum	Sergen mandalt	1993	Mechanic,	120	80	Kharaa river	Private	Sergen mandal co.ltd	yes	abnormal
15	Darkhan-Uul	Orkhon soum	Orkhon	1981	Biological	200	140	Orkhon river	Private	Darkhan USUG	yes	abnormal
16	Darkhan-Uul	Khongor soum	WWTP	1969	Mechanic	200	130	Kharaa river	Private	Emt naran co.ltd	yes	abnormal
17	Dornod	Choibalsan city	Choibalsan	1969	Mechanic	10000	6000	Area	State	Choibalsan USUG	yes	Normal
18	Dornod	Choibalsan city	Carpet industry	1989	chemical	200	200	Line to city	Private		yes	Normal
19	Dornod	Choibalsan city	meat processing	1974	mechanic	2400	400	Line to city	Private		yes	Normal
20	Dornod	Khalkh gol soum	WWTP	1976	mechanic	1000	600	Khalkh river			yes	Normal
21	Dornod	Choibalsan city	Dornod wool	1974	Mechanic	2100	200	Line to city	Private		no	not working

№	Aimag and city	District and soum	Name of WWTP	Entered date	Category of cleaning	Capacity, m^3/day		Discharge place	Ownership status	Name of ownership	Now working	Reason of not working
						Design	Current					
22	Dornod	Chuluun khoroot soum	WWTP	1973	Mechanic	250	250	Area			no	not working
23	Dornogovi	Sainshand	Central WWTP-1	1987	Biological	2700	1200	soil	Private	Chandmani ilch co.ltd	yes	abnormal
24	Dornogovi	Sainshand	Central WWTP-2	1986	Biological	2000	2000	soil	Private	Chandmani ilch co.ltd	yes	abnormal
25	Dornogovi	Urgun soum	WWTP	1989	Mechanic			soil	Private	Bayn ilch co.ltd	yes	abnormal
26	Dornogovi	Airag soum	Railway	1987	Mechanic	1400	700	soil	Private	Chandmani ilch co.ltd	yes	abnormal
27	Dornogovi	Airag soum	spar factor	1981	Mechanic	2700	3000	soil	Private	Chandmani ilch co.ltd	yes	abnormal
28	Dornogovi	Sainshand	meat processing	1986	Biological	225	100	Line to city	Private	Bayn ilch co.ltd	yes	abnormal
29	Dornogovi	Ikhkhet soum	Zulegt village, 3-r bag	1989	mechanic	3000	700	soil		Chandmani ilch co.ltd	No	not working
30	Dornogovi	Zuunbayan	Zuunbayan	1987	mechanic			Хөрсөнд			No	not working
31	Dundgovi	Mandalgovi soum	WWTP	1977	Mechanic	250	1000	Area			no	not working
32	Govi-Altai	Altai city	Altai	1991	Mechanic	1400	1400	Est river	Private	Undarga-Altai co.,ltd	No	not working
33	Govi-Altai	Erdene soum	Erdene	1988	Biological	450	140	soil	State	Soum Governor	No	not working
34	Khentii	Berkh	WWTP	1985	Mechanic and biological	700	300	Area	Private	berkh	yes	Normal
35	Khentii	Bor-Undur	WWTP	1986	Mechanic and biological	1500	1200	Area			yes	Normal
36	Khentii	Undurkhaan	WWTP	1993	Mechanic and biological	250	800	Area	State	USUG	yes	abnormal
37	Khentii	Undurkhaan	WWTP	1980	Mechanic and biological	500		Area	State	USUG	No	not working
38	Khentii	Gurvanbulag soum	WWTP	1981	Mechanic and biological	700	300	Area	State	USUG	No	not working
39	Khovd	Jargalant soum	WWTP	1987	biological and chemical	2700	3200	Buyant river	State	USUG	yes	abnormal
40	Khuvsgul	Murun city	Hospital	1971	Mechanic and biological	100	500	Murun river	State	USUG	yes	abnormal
41	Khuvsgul	Murun city	AU village	1981	mechanic	100		soil			No	not working
42	Orkhon	Jargalant soum	Ulaan tolgoi	1974	Biological	400	200	soil			yes	Normal

№	Aimag and city	District and soum	Name of WWTP	Entered date	Category of cleaning	Capacity, m^3/day		Discharge place	Ownership status	Name of ownership	Now working	Reason of not working
						Design	Current					
43	Orkhon	Jargalant soum	Central WWTP	1978	Biological	24000	27000	Kharaa river		GOK mining company	yes	Normal
44	Orkhon	Jargalant soum	Carpet industry	1980	Biological	200	200	Kharaa river			yes	Normal
45	Selenge	Sukhbaatar	Central WWTP	1991	Biological	12000	9000	Orkhon river			yes	Normal
46	Selenge	Bayangol soum	WWTP	1969	Biological	700	430	Kharaa river			yes	Normal
47	Selenge	Orkhontuul soum	WWTP	1974	Mechanic	450	400	Tuul river			yes	Normal
48	Selenge	Sukhbaatar	Railway	1957	Biological	700		Orkhon river			yes	abnormal
49	Selenge	Khutul village	Khutul viliage	1980	Biological	2200	2600	soil			yes	abnormal
50	Selenge	Altanbulag	WWTP	1970	biological	450	450	Khiagt river			no	not working
51	Selenge	Saikhan	Saihan soum	1989	biological	100	50	Soil			no	not working
52	Selenge	Shaamar	Shaamar TMS	1980	biological	200	150	Soil			no	not working
53	Selenge	Sant soum	WWTP	1980	biological	200	190	Yeven river			yes	abnormal
54	Selenge	Baruunburen	Bugaltai	1982	biological	200	100	Soil			yes	abnormal
55	Selenge	Sukhbaatar	Ar huvch, wood	1979	Biological	450		Orkhon river			yes	Normal
56	Selenge	Mandal	Zuunkharaa	1975	biological	300					no	not working
57	Selenge	Shaamar	WWTP	1973	biological	200		Soil			no	not working
58	Selenge	Bayankharaat, javkhlan	WWTP	1983	Mechanic and biological	200		Soil			no	not working
59	Selenge	Eroo	Eroo	1975	mechanic	400	400	Soil			no	not working
60	Selenge	Khuder	Худэр	1975	Mechanic	200	240	Soil			No	not working
61	Sukhbaatar	Sukhbaatar	High school	1971	Biological and mechanic	2700	800	soil	Private	Durvulj co.ltd	yes	abnormal
62	Sukhbaatar	Tumentsogt soum	WWTP	1978	mechanic	500	200	soil	Private	energy industry	no	not working
63	Tuv	Bayandelger	WWTP	1967	Mechanic	200	200	Soil			yes	Normal
64	Tuv	Bugatai station	Railway	1984	biological	50	50	Soil			yes	abnormal
65	Tuv	Zaamar	Soum	1968	mechanic	240	200	Soil	state	Soum Governor	yes	Normal
66	Tuv	Erdenesant soum	WWTP	1971	mechanic	200	200	Soil	state	Soum Governor	yes	Normal
67	Tuv	Bayantsogt soum	farmer	1973	mechanic	200		soil	State	Soum Governor	yes	Normal
68	Tuv	Zuunmod soum	Зуунмод	1995	biological	2700	2100	soil	State	Soum Governor	yes	Normal
69	Tuv	Bornuur soum	Bornuur cow	1982	mechanic			soil	Private	ZET co.ltd	no	not working
70	Tuv	Bayanchandmani soum	Servies car	1959	Mechanic	200	100	Soil			yes	abnormal
71	Tuv	Bayanchandmani soum	WWTP	1974	Mechanic	200	200	Soil			No	not working

№	Aimag and city	District and soum	Name of WWTP	Entered date	Category of cleaning	Capacity, m^3/day		Discharge place	Ownership status	Name of ownership	Now working	Reason of not working
						Design	Current					
72	Tuv	Bayanchandmani soum	WWTP	1969	Mechanic	201	201	Soil			No	not working
73	Tuv	Bayankhagai	WWTP	1989	biological	200	190	Soil			No	not working
74	Tuv	Bornuur soum	Shar gol farmer	1975	mechanic	200	150	Boroo river			No	not working
75	Tuv	Bornuur soum	WWTP	1982	biological	700	400	Boroo river	State	Soum Governor	no	not working
76	Tuv	Ugtaal	WWTP	1983	biological	200		soil	State	Soum Governor	No	not working
77	Tuv	Mungunmorid	Terelj	1985	mechanic	600	400	soil			No	not working
78	Tuv	Sumber	October	1983	biological	200	100	soil			No	not working
79	Tuv	Bayantsogt soum	Zaluuchuud	1978	biological	400	200	soil	State	Soum Governor	No	not working
80	Tuv	Sergelen soum	farmer	1973	biological	560	400	soil			No	not working
81	Tuv	Bornuur soum	Nukhurlul	1989	mechanic			soil	Not private		no	not working
82	Tuv	Bornuur soum	Bayanbuural	1993	biological	174	150	Kharaa river			yes	Normal
83	Tuv	Bayangol soum	Bayangol camp		mechanic			soil		Bayangol	no	not working
84	Ulaanbaatar city	Songinokhaikhan district	Central water treatment plant	1963, 1976, 1985	biological	230000	160000	Tuul river	State	USUG	yes	Normal
85	Ulaanbaatar city	Songinokhaikhan district	Nairamdal	1978	biological	200	200	Bayangol	State	USUG	yes	Normal
86	Ulaanbaatar city	Khan-uul district	Airport	1985	biological				State	USUG	yes	Normal
87	Ulaanbaatar city	Songinokhaikhan district	Eermel industry	1982	chemical	1200	1200	center line	Private	Soyo co.ltd	yes	Normal
88	Ulaanbaatar city	Songinokhaikhan district	Wool processing	1978	mechanic	3000	3000		Private	Eermel co.ltd	yes	Normal
89	Ulaanbaatar city	Khan-uul district	Leather	1972	mechanic	13800	13000	center line	Private	Wool	yes	Normal
90	Ulaanbaatar city	Songinokhaikhan district	meat processing	1968	mechanic	12000	7000	center line	Private	Meat processing	yes	Normal
91	Ulaanbaatar city	Bayanzurkh district	Hospital	1986	chemical	3000	145	center line	State	Hospital	yes	Normal
92	Ulaanbaatar city	Nalaikh	Nalaikh	1976	mechanic	2000	4500	Tuul river	State	USUG	yes	abnormal
93	Ulaanbaatar city	Baganuur	Baganuur	1983	biological	5600		soil	State	Buganuur USUG	yes	Normal
94	Ulaanbaatar city	Khan-uul district	Bird	1981	Mechanic and biological	500	560	soil	Private	Bukhug co.ltd	yes	Normal

№	Aimag and city	District and soum	Name of WWTP	Entered date	Category of cleaning	Capacity, m^3/day		Discharge place	Ownership status	Name of ownership	Now working	Reason of not working
						Design	Current					
95	Ulaanbaatar city	Khan-uul district	Biocombinat	1989	biological	700	1300	Tuul river	State	USUG	yes	abnormal
96	Ulaanbaatar city	Songinokhaikhan district	Farmer of pig	1980	mechanic	270	300	Tuul river	State	USUG	yes	abnormal
97	Ulaanbaatar city	Nalaikh	Nalaikh-Gorodok	1989	biological	2800		lake	State		yes	abnormal
98	Ulaanbaatar city	Bagakhangai	Undur togoi		mechanic	100	50	soil			yes	abnormal
99	Ulaanbaatar city	Bagakhangai	meat processing		mechanic	150	50	soil				abnormal
100	Ulaanbaatar city	Bagakhangai	Railway		mechanic	150	50	soil				abnormal
101	Umnugovi	Dalanzadgad	WWTP	1971	mechanic	2400	1050	soil	Private	Gunii us co.ltd	yes	Normal
102	Umnugovi	Khanbogd soum	Oyun tolgoi camp	2007	Biological and mechanic	600	111	soil	Private	AMMI co.ltd	yes	Normal
103	Umnugovi	Tsogt Tsetsii soum	Ukha hudag camp		Biological and mechanic	150	50	soil	Private	Energy resourse Co.ltd	yes	Normal
104	Uvs	Ulaangom city	Ulaangom CWWTP	1986	biological	2700	1850	Gashuun river	State	USUG	yes	abnormal
105	Uvs	Kharhiraa soum	WWTP	1985	biological	200	360	Area			no	not working
106	Uvurkhangai	Kharkhorin soum	Kharkhorin	1979	Biological	500	120	soil			yes	Normal
107	Uvurkhangai	Arvaikheer	Arvaikheer	1670	Biological and mechanic	2700	530	soil	Private	Ongi-Suvag co.ltd	yes	abnormal
108	Uvurkhangai	Ulziit soum	WWTP	1976	Biological			soil			no	not working
109	Uvurkhangai	Zuunbayan-Ulaan	WWTP	1984	Biological and mechanic			soil			no	not working
110	Uvurkhangai	Arvaikheer	Arvaikheer, industries district	1976	Biological and mechanic		1700	Sair river			no	not working
111	Zavkhan	Uliastai city	School number 1	1972	mechanic	250	200	river			yes	abnormal
112	Zavkhan	Uliastai city	meat processing	1985	mechanic	290	232	Line to city			yes	abnormal
113	Zavkhan	Uliastai city	WWTP	1985	Mechanic, biological	2700	1200	Uliastai river			no	not workig
114	Zavkhan	Bulnai soum	Bulnai WWTP	1986	Mechanic, biological	700	500	river			no	not working
115	Zavkhan	Bulnai soum	Bulnai WWTP	1972	Mechanic	200	120	river			no	not working

Annex 3. Overview of proposed treatment facilities

	1	2	3a	3b	4
Level	Ulaanbaatar	Large cities (Darkhan, Erdenet)	Urban centres with private connections		Urban centres with private connections
Classification of treatment	Very large municipal WWTP	Large municipal WWTP	Medium municipal WWTP		Small municipal WWTP
Population connected to sewage system	> 300,000 people	> 50,000 people	> 1,000 people		≤ 1,000 people
Capacity	>200,000 m^3/day	>10,000 m^3/day	>25 m^3/day		≤ 25 m3/day
Power supply	Continuous	Continuous	Continuous	Not continuous	Not continuous
Proposed treatment set-up	-Raw water tanks fitted with pumps and screening units; -Primary sedimentation tanks; -Aeration tanks, biological activated sludge treatment; -Secondary sedimentation; -Disinfection with chloride in contact tank.	-Raw water tanks fitted with pumps and screening units; -Primary sedimentation tanks; -Aeration tanks, biological activated sludge treatment; -Secondary sedimentation; -Disinfection with chloride in contact tank.	-Raw water tank(s) fitted with pumps and screening units; -Primary sedimentation tank(s); -Aeration tank(s), biological activated sludge treatment; -Secondary sedimentation; -Disinfection with chloride in contact tank.	-Influent receiving tank, which can be closed for maintenance; -Primary sedimentation tank(s); -Secondary sedimentation tank(s); -additional sand/gravel filter (when groundwater tables are too high for direct soil infiltration);	-Influent receiving tank, which can be closed for maintenance; -Three compartment tank, existing of: o first compartment: primary sedimentation; o second compartment: secondary sedimentation with or without aeration; o third compartment: final sedimentation; -additional sand/gravel filter (when groundwater tables are too high for direct soil infiltration);
Sludge treatment	-Collection of sludge from sedimentation tanks by sludge pumps -Mechanical dewatering using sludge press. -Natural dewatering using sludge drying beds.	-Collection of sludge from sedimentation tanks by sludge pumps -Dewatering: Natural dewatering using sludge drying beds.	-Collection of sludge from sedimentation tanks by sludge pumps -Dewatering: Natural dewatering using sludge drying beds.	-Sludge from sedimentation tank(s) to drying beds by (mobile) sludge pumps -Dewatering: Natural dewatering using sludge drying beds.	-Sludge from third compartment to drying beds by mobile sludge pump -Dewatering: Natural dewatering using sludge drying beds.

Annex 4. Basic costs waste water treatment facilities

Waste water treatment

Technology	Purpose	Efficiency	Investment cost of 100 m3/h		Operational costs per m3 (100 m3/h system)	
Sceptic tank	Flotation Sedimentation Anaerobic degradation of organic material	60-95% of non-soluble COD and N-Kjeldahl	Low		Periodic removal of content and discharge to public WWTP	
Fats/ greases separator	Flotation	50-90% of fats and greases	Low		Periodic removal of content.	
Oil separator	Flotation	50-90% of oils	75.000	225.000	0,05	0,09
Lagooning/ sedimentation	Sedimentation	60-70% suspended solids	100.000	250.000	0,02	
Sieve	Removal large particles	5-25% suspended solids 5-20% of BOD	25.000		0,002	
Buffer tanks	Egalisation Degradation BOD	- 5-50% BOD (dairy industry)	15.000	45.000	0,01	
Aerobic system (SBR)	BOD removal Nitrogen removal fosfor removal (optional)	>95% BOD >95% nitrogen >95% fosfor	3.500.000	6.000.000	0,60	1,10
Conventional Active Sludge (CAS)	BOD removal	>95% BOD	3.500.000	6.000.000	0,60	0,80
Dissolved Air Flotation (DAF)	Oils, fats, greases Suspended solids	80-95% oils, fats, greases (meat industry) 80-95% suspended solids	450.000	900.000	?	?

Effluent disinfection

The rate of effluent disinfection depends on the fecal coliforms (FC) which are allowed to enter the receiving water. For the cost estimate the technology chosen is UV radiation because it can function independently and without chemicals, provided that the turbidity of effluent (thus correct functioning of final sedimentation) is according specification and design. The investment cost of UV systems is higher compared to chlorine dosing, but the operational costs are lower as these are limited by lamp replacements after ±8,000 hours.

For effluent disinfection typically open UV systems are applied. For the Mongolian situation a high UV dose rate is advised as at many places in Mongolia river water adjacent to discharge points is used for many purposes, including cattle watering and drinking water use.

	Type UV system (UV Transmission (254nm) of the water: 60%)			
	Closed system		Open system	
Disinfection target	< 10 FC per 100ml	200 FC per 100ml	< 10 FC per 100ml	200 FC per 100ml
Biocide UV dose (mJ/cm²)	40	15	40	15
Capacity (m³/h)	2		2	
Type Trojan UV System	SwiftSC A01	SwiftSC A02	PTP 3025-1	PTP 3025-1
Investment (Euro)	€ 2,500	€ 5,000	€ 1,500	€ 1,500
Capacity (m³/h)	100		100	
Type Trojan UV System	SwiftSC C18	SwiftSC C08	PTP 3700-1	PTP 3400-1
Investment (Euro)	€ 35,000	€ 17,500	€ 17,500	€ 12,500
Capacity (m³/h)	500		500	
Type Trojan UV System	2 x SwiftSC C32	SwiftSC C32	UV3000+ 1C6M8L	UV3000+ 1C3M6L
Investment (Euro)	€ 100,000	€ 50,000	€ 100,000	€ 60,000
Capacity (m³/h)	2000		2000	
Type Trojan UV System	8 x SwiftSC C32	4 x SwiftSC C30	UV3000+ 1C22M8L	UV3000+ 1C9M8L
Investment (Euro)	€ 400,000	€ 200,000	€ 250,000	€ 125,000
Capacity (m³/h)	10000		10000	
Type Trojan UV System	40 x SwiftSC C32	20 x SwiftSC C30	UV3000+ 2C110M8L	UV3000+ 1C42M8L
Investment (Euro)	€ 2,000,000	€ 1,000,000	€ 1,500,000	€ 450,000

Annex 5. Length of sewage and drinking water networks

№	Name		Inhabitant		Aimag name	Sewages (km)					Drinking water line (km)			
	English	Mongolian	2000	2006		Total	Plastic	Steel	Iron	Concrete	Total	Steel	Iron	Plastic
1	Ulaanbaatar	Улаанбаатар	760.077	862.842	Ulaanbaatar	146					350			
2	Erdenet	Эрдэнэт	68.31	82.137	Orkhon	40					260			
3	Darkhan	Дархан	65.791	73.783	Darkhan-Uul	223.6			223.6		215.3	215.3		
4	Choibalsan	Чойбалсан	41.714	44.88	Dornod	20.8		15	5.8		47.8	46.8		
5	Ulgii	Өлгий	28.06	30.483	Bayan-Ulgii	17				8.5	20		17.6	2.4
6	Sainshand	Сайншанд	25.21	29.386	Dornogobi	54.2					10.5		10.5	
7	Ulaangom	Улаангом	26.319	28.434	Ubs	7.4					7.9	2.9	2.6	1.3
8	Khovd	Ховд	26.023	28.301	Khovd	18.3		18.3			18.2	18.2		
9	Murun	Мөрөн		28.117	Khuvsgul	6.9	3.04	2.57		1.3	5.3			5.3 PE
10	Uliastai	Улиастай	24.276	26.493	Zavkhan	12.2	2.7		9.5		11.3	10.8		0.5
11	Sukhbaatar	Сухбаатар		24.622	Selenge	26.4					35.5			
12	Bayankhongor	Баянхонгор	22.066	23.456	Bayankhongor	10.8			10.88		11.5		11.5	
13	Arvaikheer	Арвайхээр	19.058	20.94	Uvurkhangai	7.7			7.15	0.55	7.6		6.75	0.85
14	Tsetserleg	Цэцэрлэг	18.519	19.305	Arkhangai	18.3			17.3	1	10.3	10.3		
15	Zuunkharaa	Зүүнхараа		19.093	Selenge									
16	Altai	Алтай	18.023	18.908	Gobi-Altai	10		10			14.7	14.7		
17	Zuunmod	Зуунмод	16.227	18.048	Tuv	22		12	10		23	23		
18	Bulgan	Булган	16.239	17.564	Bulgan	2	2				8.5	8.5		
19	Nalaikh	Налайх		17.026	Ulaanbaatar	14		10	4		7.6		7.6	
20	Baruun-Urt	Баруун-Урт	15.133	15.93	Sukhbaatar	10.4		10.4			28.4	28.4		
21	Mandalgobi	Мандалговь	14.517	15.608	Dundgobi	5		5			80	80		
22	Dalanzadgad	Даланзадгад	14.183	15.269	Umnugobi	12.8			8.96	3.84	24.7		24.7	
23	Undurkhaan	Өндөрхаан		14.837	Khentii	14.2					18.6			
24	Choir	Чойр	8.983	10.085	Gobi-Sumber	7.8			7.8		5	5		

Annex 6. Compact Treatment Facilities

1: Septic tank and septic drain field

A septic tank, the key component of the septic system, is a small scale waste water treatment system common in areas with no connection to main sewage pipes provided by local governments or private corporations. (Other components, typically mandated and/or restricted by local governments, optionally include pumps, alarms, sand filters, and clarified liquid effluent disposal means such as a septic drain field, ponds, natural stone fibre filter plants or peat moss beds). Septic systems are a type of On-Site Sewage Facility (OSSF). In North America approximately 25% of the population relies on septic tanks; this can include suburbs and small towns as well as rural areas (Indianapolis is an example of a large city where many of the city's neighborhoods are still on separate septic systems). In Europe they are generally limited to rural areas only.

The term "septic" refers to the anaerobic bacterial environment that develops in the tank and which decomposes or mineralizes the waste discharged into the tank. Septic tanks can be coupled with other on-site waste water treatment units such as biofilters or aerobic systems involving artificial forced aeration.

Periodic preventive maintenance is required to remove the irreducible solids which settle and gradually fill the tank, reducing its efficiency. In most jurisdictions this maintenance is required by law, yet often not enforced. Those who ignore the requirement will eventually be faced with extremely costly repairs when solids escape the tank and destroy the clarified liquid effluent disposal means. A properly maintained system, on the other hand, can last for decades and possibly a lifetime.

Description

A septic tank generally consists of a tank (or sometimes more than one tank) of between 1,000 and 2,000 gallons (4000 - 7500 litres) in size connected to an inlet waste water pipe at one end and a septic drain field at the other. These pipe connections are generally made via a T pipe which allows liquid entry and exit without disturbing any crust on the surface. Today the design of the tank usually incorporates two chambers (each of which is equipped with a manhole cover) which are separated by means of a dividing wall which has openings located about midway between the floor and roof of the tank.

Figure: Septic tank with infiltration tunnel

Waste water enters the first chamber of the tank, allowing solids to settle and scum to float. The settled solids are anaerobically digested reducing the volume of solids. The liquid component flows through the dividing wall into the second chamber where further settlement takes place with the excess liquid then draining in a relatively clear condition from the outlet into the leach field, also referred to as a drain field, or seepage field, depending upon locality.

The remaining impurities are trapped and eliminated in the soil, with the excess water eliminated through percolation into the soil (eventually returning to the groundwater), through evaporation, and by uptake through the root system of plants and eventual transpiration. A piping network, often laid in a stone filled trench (see weeping tile), distributes the waste water throughout the field with multiple drainage holes in the network. The size of the leach field is proportional to the volume of waste water and inversely proportional to the porosity of the drainage field. The entire septic system can operate by gravity alone, or where topographic considerations require, with inclusion of a lift pump. Certain septic tank designs include siphons or other methods of increasing the volume and velocity of outflow to the drainage field. This helps to load all portions of the drainage pipe more evenly and extends the drainage field life by preventing premature clogging.

Waste that is not decomposed by the anaerobic digestion eventually has to be removed from the septic tank, or else the septic tank fills up and undecomposed waste water discharges directly to the drainage field. Not only is this bad for the environment, but if the sludge overflows the septic tank into the leach field, it may clog the leach field piping or decrease the soil porosity itself, requiring expensive repairs.

How often the septic tank has to be emptied depends on the volume of the tank relative to the input of solids, the amount of indigestible solids and the ambient temperature (as anaerobic digestion occurs more efficiently at higher temperatures). The required frequency varies greatly depending on jurisdiction, usage, and system characteristics. Some health authorities require tanks to be emptied at prescribed intervals, while others leave it up to the determination of the inspector. Some systems require pumping every few years or sooner, while others may be able to go 10-20 years between pumpings. Contrary to what many believe, there is no "rule of thumb" for how often tanks should be emptied. An older system with an undersized tank that is being used by a large family will require much more frequent pumping than a new system used by only a few people. Anaerobic decomposition is rapidly re-started when the tank re-fills.

A properly designed and normally operating septic system is odour free and, besides periodic inspection and pumping of the septic tank, should last for decades with no maintenance.

A well designed and maintained concrete, fibreglass or plastic tank should last about 50 years.

Potential problems

- Excessive dumping of cooking oils and grease can cause the inlet drains to block. Oils and grease are often difficult to degrade and can cause odour problems and difficulties with the periodic emptying.
- Flushing non-biodegradable hygiene products such as sanitary towels and cotton buds will rapidly fill or clog a septic tank; these materials should not be disposed of in this way.
- The use of garbage disposers for disposal of waste food can cause a rapid overload of the system and early failure.

- Certain chemicals may damage the working of a septic tank, especially pesticides, herbicides, materials with high concentrations of bleach or caustic soda (lye) or any other inorganic materials such as paints or solvents.
- Roots from trees and shrubbery growing above the tank or the drain field may clog and or rupture them.
- Playgrounds and storage buildings may cause damage to a tank and the drainage field. In addition, covering the drainage field with an impervious surface, such as a driveway or parking area, will seriously affect its efficiency and possibly damage the tank and absorption system.
- Excessive water entering the system will overload it and cause it to fail. Checking for plumbing leaks and practising water conservation will help the system's operation.
- Over time biofilms develop on the pipes of the drainage field which can lead to blockage.
- Septic tanks by themselves are ineffective at removing nitrogen compounds that can potentially cause algal blooms in receiving waters; this can be remedied by using a nitrogen-reducing technology, or by simply ensuring that the leach field is properly sited to prevent direct entry of effluent into bodies of water.

Environmental issues

Some pollutants, especially sulfates, under the anaerobic conditions of septic tanks, are reduced to hydrogen sulfide, a pungent and toxic gas. Methane, a major 'greenhouse gas' is another by-product. Nitrates and organic nitrogen compounds are reduced to ammonia. Because of the anaerobic conditions, fermentation processes take place, which ultimately generate carbon dioxide and methane.

The fermentation processes cause the contents of a septic tank to be anoxic with a low redox potential, which keeps phosphate in a soluble and thus mobilized form. Because phosphate can be the limiting nutrient for plant growth in many ecosystems, the discharge from a septic tank into the environment can trigger prolific plant growth including algal blooms which can also include blooms of potentially toxic cyanobacteria.

Soil capacity to retain phosphorus is large compared with the load through a normal residential septic tank. An exception occurs when septic drain fields are located in sandy or coarser soils on property adjoining a water body. Because of limited particle surface area, these soils can become saturated with phosphate. Phosphate will progress beyond the treatment area, posing a threat of eutrophication to surface waters.

In areas with high population density, groundwater pollution levels often exceed acceptable limits. Some small towns are facing the costs of building very expensive centralized waste water treatment systems because of this problem, owing to the high cost of extended collection systems. To slow development, building moratoriums and limits on the subdivision of property are often imposed. Ensuring existing septic tanks are functioning properly can also be helpful for a limited time, but becomes less effective as a primary remediation strategy as population density increases.

Figure: Septic tank before installation

Figure: Same tank partially installed in the ground

Trees in the vicinity of a concrete septic tank have the potential to penetrate the tank as the system ages and the concrete begins to develop cracks and small leaks. Tree roots can cause serious flow problems due to plugging and blockage of drain pipes, but the trees themselves tend to grow extremely vigorously due to the continuous influx of nutrients into the septic system.

2: Aerobic treatment system

An aerobic treatment system or ATS, often called (incorrectly) an aerobic septic system is a small scale waste water treatment system similar to a septic tank system, but which uses an aerobic process for digestion rather than just the anaerobic process used in septic systems. These systems are commonly found in rural areas where public sewers are not available, and may be used for a single residence or for a small group of homes.

Unlike the traditional septic system, the aerobic treatment system produces a high quality secondary effluent, which can be sterilized and used for surface irrigation. This allows much greater flexibility in the placement of the leach field, as well as cutting the required size of the leach field by as much as half.

Process

The ATS process generally consists of the following phases:

- Pre-treatment stage to remove large solids and other undesirable substances from the waste water; this stage acts much like a septic system, and an ATS may be added to an existing septic tank to further process the primary effluent.
- Aeration stage, where the aerobic bacteria digest the biological wastes in the waste water.
- Settling stage to allow any undigested solids to settle. This forms a sludge which must be periodically removed from the system.
- Disinfecting stage, where chlorine or similar disinfectant is mixed with the water, to produce an antiseptic output.
- The disinfecting stage is optional, and is used where a sterile effluent is required, such as cases where the effluent is distributed above ground. The disinfectant typically used is tablets of calcium hypochlorite, which are specially made for waste treatment systems. Unlike the chlorine tablets used in swimming pools, which is stabilized for resistance to breakdown in ultraviolet

light, the tablets used in waste treatment systems is intended to break down quickly in sunlight. Stabilized forms of chlorine will persist after the effluent is dispersed, and can kill off plants in the leach field.

Figure: Process overview of a Sequencing Batch Reactor (SBR)

Since the ATS contains a living ecosystem of microbes to digest the waste products in the water, excessive amounts of items such as bleach or antibiotics can damage the ATS environment and reduce treatment effectiveness. Non-digestible items should also be avoided, as they will build up in the system and require more frequent sludge removal.

Types of aerobic treatment systems

Small scale aerobic systems generally use one of two designs, fixed-film systems, or continuous flow, suspended growth aerobic systems (CFSGAS). The pre-treatment and effluent handling are similar for both types of systems, and the difference lies in the aeration stage.

Fixed film systems

Fixed film systems use a porous medium which provides a bed to support the biomass film that digests the waste material in the waste water (also called carrier material on which a biofilm can grow). Designs for fixed film systems vary widely, but fall into two basic categories (though some systems may combine both methods). The first is a system where the media is moved relative to the waste water, alternately immersing the film and exposing it to air, while the second uses a stationary media, and varies the waste water flow so the film is alternately submerged and exposed to air. In both cases, the biomass must be exposed to both waste water and air for the aerobic digestion to occur. The film itself may be made of any suitable porous material, such as formed plastic or peat moss. Simple systems use stationary media, and rely on intermittent, gravity driven waste water flow to provide periodic exposure to air and waste water. A common moving media system is the rotating biological contactor (RBC), which uses disks rotating slowly on a horizontal shaft. Approximately 40 percent of the disks are submerged at any given time, and the shaft rotates at a rate of one or two revolutions per minute.

Continuous flow, suspended growth aerobic systems

CFSGAS systems, as the name imply, are designed to handle continuous flow, and do not provide a bed for a bacterial film, relying rather on bacteria suspended in the waste water. The suspension and aeration are typically provided by an air pump, which pumps air through the aeration chamber, providing a constant stirring of the waste water in addition to the oxygenation. A medium to promote fixed film bacterial growth may be added to some systems designed to handle higher than normal levels of biomass in the waste water.

Comparison to traditional septic systems

The aeration stage and the disinfecting stage are the primary differences from a traditional septic system; in fact, an aerobic treatment system can be used as a secondary treatment for septic tank effluent. These stages increase the initial cost of the aerobic system, and also the maintenance requirements over the passive septic system. Unlike many other biofilters, aerobic treatment systems require a constant supply of electricity to drive the air pump increasing overall system costs. The disinfectant tablets must be periodically replaced, as well as the electrical components (air compressor) and mechanical components (air diffusers). On the positive side, an aerobic system produces a higher quality effluent than a septic tank, and thus the leach field can be smaller than that of a conventional septic system, and the output can be discharged in areas too environmentally sensitive for septic system output. Some aerobic systems recycle the effluent through a sprinkler system, using it to water the lawn where regulations approve.

Effluent quality

Since the effluent from an ATS is often discharged onto the surface of the leach field, the quality is very important. A typical ATS will, when operating correctly, produce an effluent with less than 30 mg/liter biochemical oxygen demand, 25 mg/liter total suspended solids, and 10,000 cfu/mL fecal coliform bacteria. This is clean enough that it cannot support a biomat or "slime" layer like a septic tank.

ATS effluent is relatively odorless; a properly operating system will produce effluent that smells musty, but not like sewage. Aerobic treatment is so effective at reducing odors, that it is the preferred method for reducing odor from manure produced by farms.

Figure: Installing a treatment facility

Figure: Compact for up to 200 inhabitants

Annex 7. Performance of Tannery WWTPs

Parameter	COD		BOD_5		SS		Chrome		Sulphide		N (Kjeldahl)		Sludge
% or mg/l	%	mg/l	%	mg/l	%	mg/l	%	mg/l	%	mg/l	%	mg/l	kg DS / t raw hide
PRETREATMENT													
Grease removal (dissolved air flotation)	20 - 40												
Sulphide oxidation (liming and rinsing liquors)	10									10			
Chromium precipitation								5 - 10 1 - 2*)					
PRIMARY TREATMENT													
Mixing + Sedimentation	25 - 35		25 - 35		50 - 70			20 - 30			25 - 35		80
Mixing + Chemical treatment + Sedimentation	50 - 65		50 - 65		80 - 90			2 - 5		2 - 10	40 - 50		150 - 200
Mixing + Chemical treatment + Flotation	55 - 75		55 - 75		80 - 95			2 - 5		2 - 5	40 - 50		150 - 200
BIOLOGICAL TREATMENT													
Primary or chemical + Extended aeration	85 - 95	200 - 400	90 - 97	20 - 60	90 - 98	20 - 50		<1		<1	50	150	130 - 150
Primary or chemical + Extended aeration with nitrification and denitrification	85 - 95	200 - 400	90 – 97	20 – 60	90 - 98	20 - 50		<1		<1	80 - 90	30 - 60	130 - 150
Primary or chemical + Aerated facultative lagooning	80 - 90	300 - 500	85 – 95	60 - 100	85 - 90	80 - 120		<1		<1	50	80	100 - 140
Anaerobic treatment (lagoon or UASB** with 66 % domestic sewage)	65 - 75	500 - 700	60 - 70	150 - 200	50 - 80	100 - 200		<2	0		20 – 30		60 - 100

These data represent typical values for tannery waste water treatment efficiency for conventional process liquors for production of finished leather from raw material.
*) Reported values in the Netherlands, measured as total chrome in a daily composite sample, after sedimentation or flotation, of the separate chrome-containing effluent before mixing
** Upward anaerobic sludge blanket

Table 4.17: Performance of waste water treatment plant
Source: tan/tm/43/World Leather November 1996

Annex 8. Cost estimates municipal WWTPs

No.	Urban centre	Current condition of WWTP	Population Estimate 2010	Population Estimate 2030	Expected sewage connections		Expected water use per capita *(ltr/day)*	Expected waste water *(m³/day)*	Expected length sewage pipes *(m)*	Unit costs (USD)		Total cost estimate (million USD)		
					as %	as number				WWTP *(USD per m³/day)*	sewage pipeline *(USD per m)*	WWTP	sewage pipeline	WWTP and sewage pipeline
1.	Ulaanbaatar	normal	1,131,233	2,272,033	72.5	1,647,224	130	214,139	1,647,224	2,500	80	348.8	72.7	421.5
2.	Erdenet	normal	84,950	95,243	72.5	69,051	130	8,977	69,051	2,500	80	8.4	1.1	9.5
3.	Darkhan	normal	77,434	87,142	72.5	63,178	130	8,213	63,178	2,500	80	7.8	1.0	8.8
4.	Choibalsan	normal	40,283	45,714	72.5	33,143	130	4,309	33,143	2,500	80	4.1	0.5	4.7
5.	Olgii	abnormal	29,068	36,480	72.5	26,448	130	3,438	26,448	2,500	80	7.2	1.4	8.7
6.	Sainshand	abnormal	21,147	27,292	72.5	19,787	130	2,572	19,787	2,500	80	5.4	1.1	6.5
7.	Ulaangom	abnormal	22,907	23,044	72.5	16,707	130	2,172	16,707	2,500	80	4.4	0.8	5.2
8.	Hovd	abnormal	27,149	33,283	72.5	24,130	130	3,137	24,130	2,500	80	6.6	1.3	7.9
9.	Moron	abnormal	36,141	36,141	72.5	26,202	130	3,406	26,202	2,500	80	6.8	1.3	8.1
10.	Uliastai	not working	14,691	9,167	72.5	6,646	130	864	6,646	2,500	80	3.5	0.9	4.3
11.	Sukhbaatar	normal	21,942	25,444	72.5	18,447	130	2,398	18,447	2,500	80	2.4	0.3	2.7
12.	Bayankhongor	normal	26,770	40,470	72.5	29,341	130	3,814	29,341	2,500	80	5.1	0.9	6.1
13.	Arvakheer	abnormal	25,777	29,772	72.5	21,585	130	2,806	21,585	2,500	80	5.8	1.1	6.9
14.	Tsetserleg	normal	20,054	29,695	72.5	21,529	130	2,799	21,529	2,500	80	3.7	0.7	4.4
15.	Altai	not working	16,830	11,562	72.5	8,382	130	1,090	8,382	2,500	80	4.0	1.0	4.9
16.	Zuunmod	normal	15,295	21,796	72.5	15,802	130	2,054	15,802	2,500	80	2.6	0.5	3.1
17.	Bulgan	abnormal	11,638	15,483	72.5	11,225	130	1,459	11,225	2,500	80	3.1	0.6	3.7
18.	Nalaikh	abnormal	31,458	50,000	72.5	36,250	130	4,713	36,250	2,500	80	10.3	2.2	12.5
19.	Baruun-Urt	abnormal	14,297	24,087	72.5	17,463	130	2,270	17,463	2,500	80	5.0	1.1	6.1
20.	Mandalgovi	not working	10,320	10,200	72.5	7,395	130	961	7,395	2,500	80	2.4	0.6	3.0
21.	Dalanzadgad	normal	17,907	25,063	72.5	18,171	130	2,362	18,171	2,500	80	3.0	0.5	3.5
22.	Undurkhaan	not working	17,272	17,058	72.5	12,367	130	1,608	12,367	2,500	80	4.1	1.0	5.1
23.	Choir	not working	9,207	14,149	72.5	10,258	130	1,334	10,258	2,500	80	3.3	0.8	4.2
	Total											457.7	93.5	551.1

Note: the cost estimate of Ulaanbaatar, Erdenet and Darkhan was calculated for comparison purposes according the methodology for medium size WWTPs

Annex 9. Upgrade and extension plans Khargia WWTP

Total investment cost

?	Object	Time	Request work	Cost /million tug/
I period				
1	Building of office	2010	-	154
2	Pipeline from WWTP to sewage	2010	to do pipe line work	43,5
3	08 Central pumping station	2010	Service of station	137,6
4	09 Sand filter	2010	Sand filter work	38,6
5	06 Station of chemic	2010-2011	New	39,1
6	04 Station of chlorium	2010-2011	Roof works	175,5
7	03 Lime station	2010-2011	to built Substation	121,4
8	010-Station /ray sedminetation/	2010-2011	ray sedminetation	27,2
9	011-Station /sludge/	2010-2011	Service work	94,1
10	05-07 lying sedminetation	2010-2011	Service work	495,1
11	chromium and lime line	2010-2011	Service work	18,4
12	warm supply and aerotion	2011	Service work	91,8
13	Electricity , automat	2011	Electricity , automat	130
14	Sludge area	2010	to clean sludge area	173,2
	Total investment cost			**1 740.0**
II period				
2	Mechanical sieve/screen	2011	3 ? exsep	2 750.0
4	Membrane Bio Reactor	2011	To install Membrian technology	11000
				13750
				15490

(The CETR investment costs vary from only about US$ 250 to nearly US$ 900 m^3 of installed capacity, the average being about US$ 600 m^3/day.)

?	Indicator	Unit cost		Total	
		Unit m3/day	$	Unit m^3/day	$
1	Minimum	1	250	13000	3250000
2	Maximum	1	900	13000	11700000
3	Average	1	600	13000	7800000

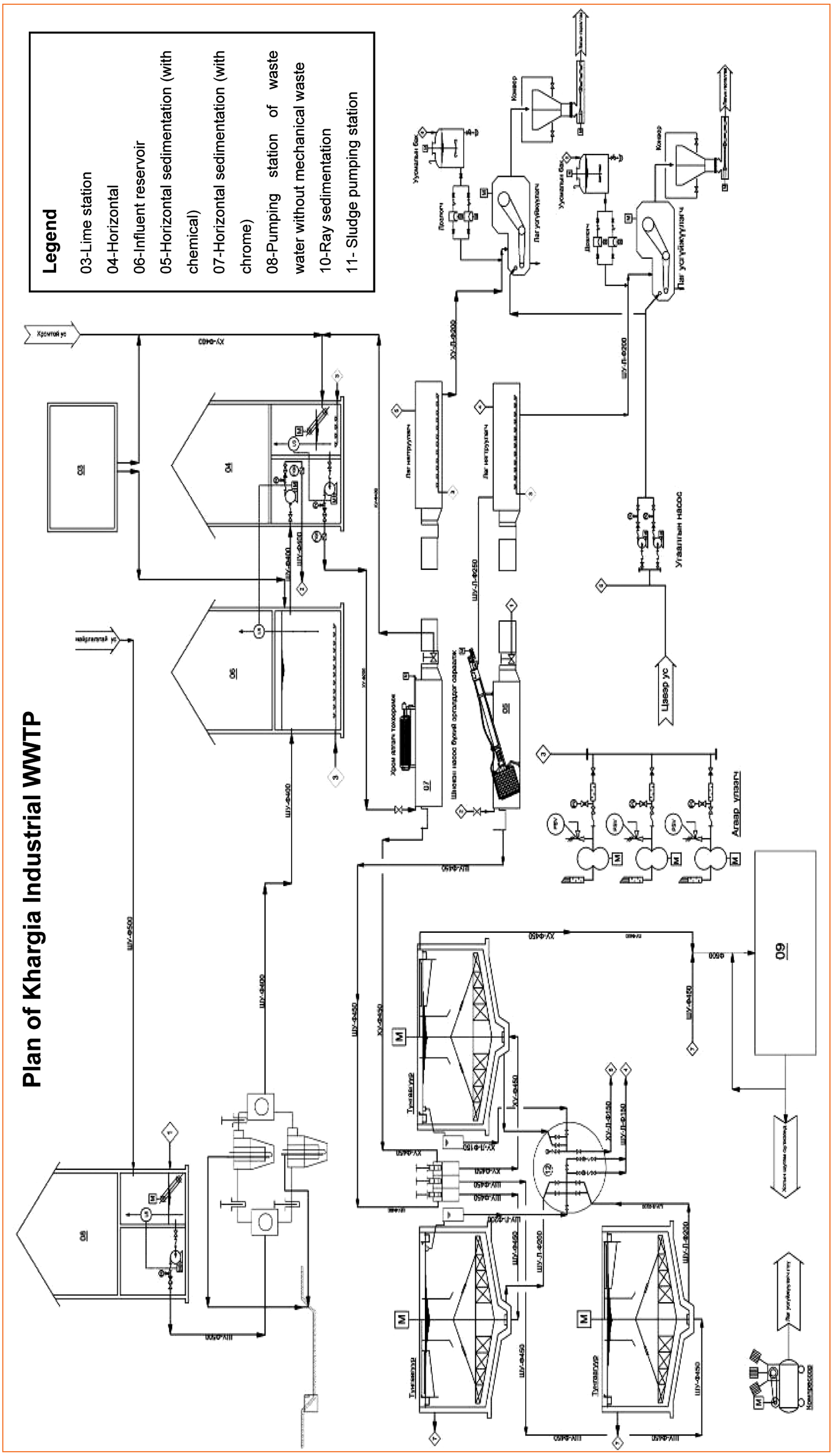


Figure: Plan of Khargia Industrial WWTP

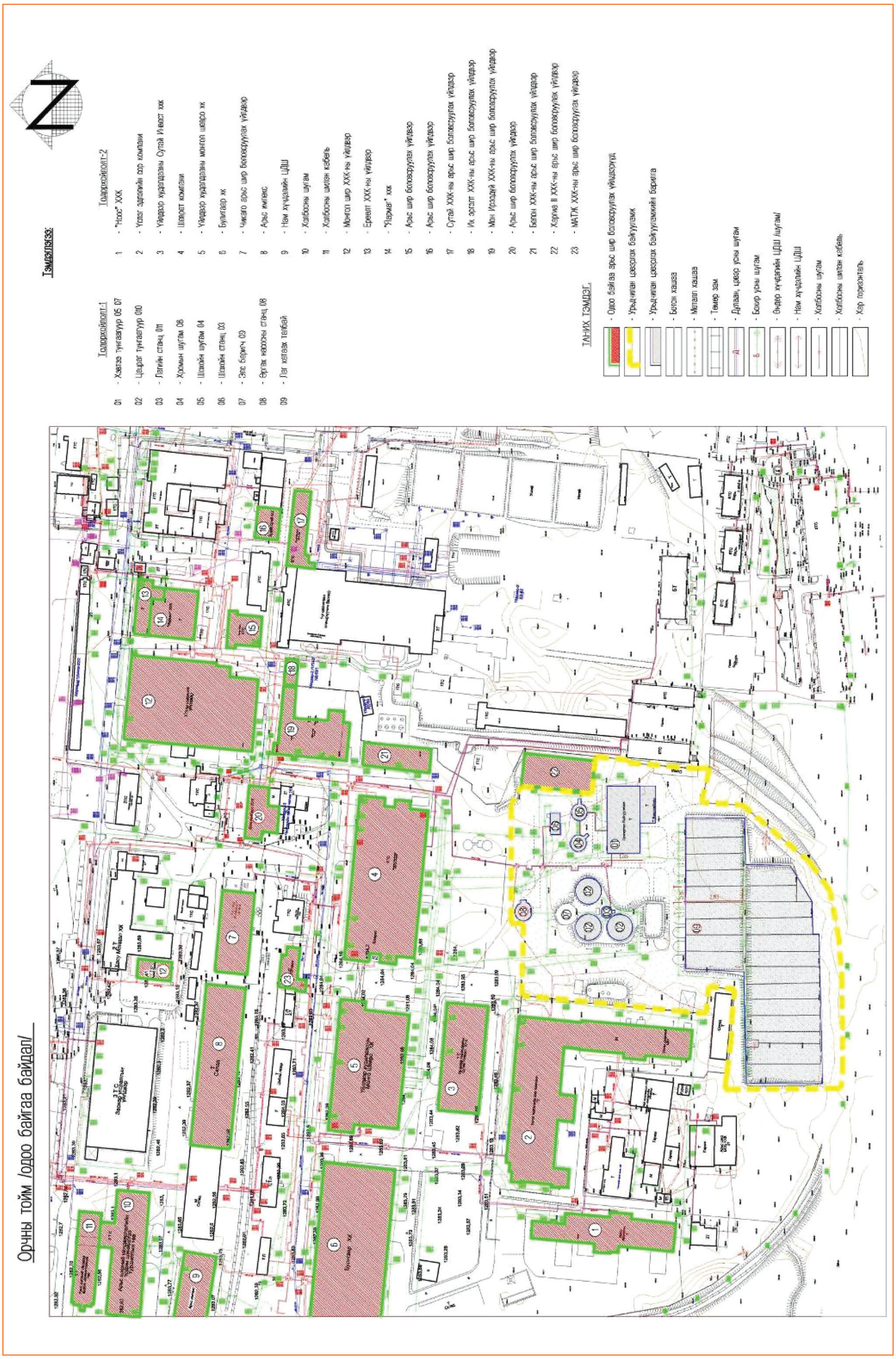
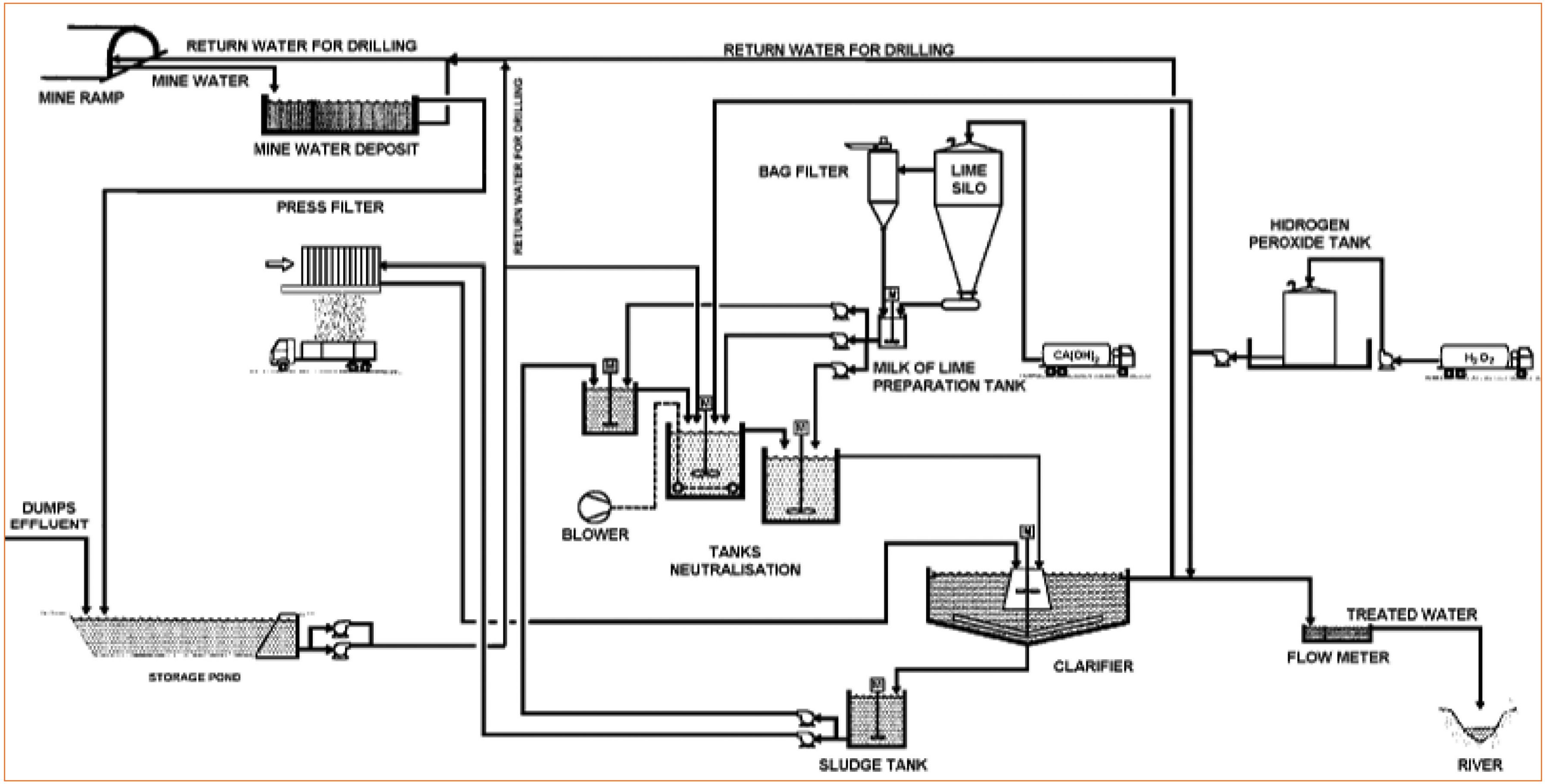


Figure: Location of Khargia WWTP and connected industries

Annex 10. Example of a mining WWTP



Part 6.
LEGAL ARRANGEMENTS FOR INTEGRATED WATER RESOURCES MANAGEMENT

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1. Introduction

1.1. General introduction

The current Water Law of Mongolia was adopted on 22 April, 2004 with the new concept and understanding including a "water resources management plan". Another significant change was the establishment of the Governmental Agency in charge of water issues (Article 12.2.1, Water Law), giving it the mandate to develop the "water resources management plan.

For Mongolia to embark on the implementation of the "water resources management plan", it would need to assess the legal environment for water resources management, are the Dublin principles of water resources management included in legal acts?

The report was developed to assess the current legal environment to implement the "integrated water resources management planning".

1.2. Data, data sources and data used

The following data were used to make the comprehensive assessment of legal arrangements for "***integrated*** water resources management".

1. Environment protection laws, and other branch laws, bylaws, norms and standards (Attachment 1)
2. Policy documents:
   - At national level:
     - Mongolian Millennium Development Goals and Targets
     - Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia;
     - National Water Program;
     - Government Policy on Ecology
     - Regional Development Programs (Western, Eastern, Central and Khangain)
     - Concept of National Security
     - Others
   - At local level:
     - Development program of Ulaanbaatar city
     - Development program of Tuv aimag
     - Development program of Orkhon aimag
     - Development program of Uvurkhangai aimag
     - Development program of Selenge aimag
     - Others
3. Transboundary agreements, international conventions and agreements which Mongolia joined or ratified
4. Technical reports of Environment protection programs and projects:
   - "Technical Report on improvement of water economy management of Mongolia" (Report of the Dr Z.Batbayar, National consultant of the IWRM project, Inception Phase);
   - Report on "Strengthening Environment Management and Legal Environment

basing Stakeholder Participation", Innovation of Environment Project (World Bank, Trust Fund of the Netherlands, Ministry of Nature and Environment, Federation of Environment Protection NGOs, 2006);

- Report on "Environmental Law and Institutional Framework" Strengthening Environmental Governance in Mongolia Project (UNDP, MNE, 2009); "Assessing Environmental Laws" Strengthening Environment Management Capacity in Mongolia Project (UNDP, 2009);
- and others

5. Background papers, guide books and hand books by international organizations, such as:
    - "The Dublin Principles for Water as Reflected in a Comparative Assessment of Institutional and Legal Arrangements for Integrated Water Resources Management" Technical Advisory Group (TAC) Background paper. The report on water legislation and institutional arrangements submitted in compliance with agreements reached during the June 10-13, 1996 Copenhagen meeting of the TAC of the Global Water Partnership, identifies manners in which the Dublin Principles about water reflect, coincide, or agree with practices and principles accepted by water legislation and institutions in a number of countries: Chile, Mexico, South Africa, China. The report was printed in June, 1999. The technical report of "Mongolian Legal Arrangements and Water Resources Management" was developed within the content of this background paper.
    - "Status Report on Integrated Water Resources Management and Water Efficiency Plans" prepared for the 16th session of the Commission on Sustainable Development, May, 2008 from UN WATER. The report is based on a survey covering 104 countries of which 77 are developing or countries in transition and 27 are developed. In 2000 heads of states adopted the Millennium Declaration on the basis of which the UN instituted the Millennium Development Goals. As a follow-up to the MDGs it was further agreed at the World Summit on Sustainable Development in Johannesburg in 2002, through the Johannesburg Plan of Implementation, to "Develop integrated water resources management and water efficiency plans by 2005, with support to developing countries, through action at all levels". And there was further discussion on IWRM and water efficiency plan at the Commission of Sustainable Development's 12th and 13th meetings where it was decided that in 2008 (CSD's 16th meeting) there should be an assessment of progress made towards meeting the target. The monitoring analyses within the Report draws primarily on the questionnaires carried out by UN-DESA (United Nations Department for Economic and Social Affairs) and UNEP, UN Statistics, and GWP.

The above listed data were collected from the following data sources:

Websites:

- www.legalinfo.mn;
- www.cap-net.org;
- www.internationalwaterlaw.org;
- www.unwater.org;
- www.voda.mnr.gov.ru;
- www.ramsar.org;
- www.caresd.net;
- www.gwp.org;.

Books:

- Compendium of Laws of Mongolia, a Mongolian Citizens Reference Book (Asia Foundation, 2008);
- Water Legislative Acts of Mongolia (GTZ and Mongolian State Profficional Inspection Agency, 2008);
- Water Law-an Introduction to Water Law, Policies and Institutions (J. Gupta);
- Amur-Heilong River Basin Reader (WWF, 2008);
- International Law (M. Dugersuren, O.Khosbayar, 1996)

1.2. Methodology

The starting point for the evaluation of the legal environment of water resources in Mongolia are the guiding principles for integrated water resources management, the Dublin Principles. The Dublin Principles concisely state the main issues and thrust of water management:

1. *Fresh water is a finite and vulnerable resources, essential to sustain life, development and the environment;*
2. *Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels;*
3. *Women play a central part in the provision, management, and safeguarding of water;*
4. *Water is a public good and has a social and economic value in all its competing uses.*

These four principles cover environmental, social, political and economic issues, which justifies the term "integrated".

We analysed whether and how the Dublin Principles on IWRM had been included in the various elements of the water legislation. The assessment of the legal environment for water resources of Mongolia was done following the stepwise approach presented in Figure 1.

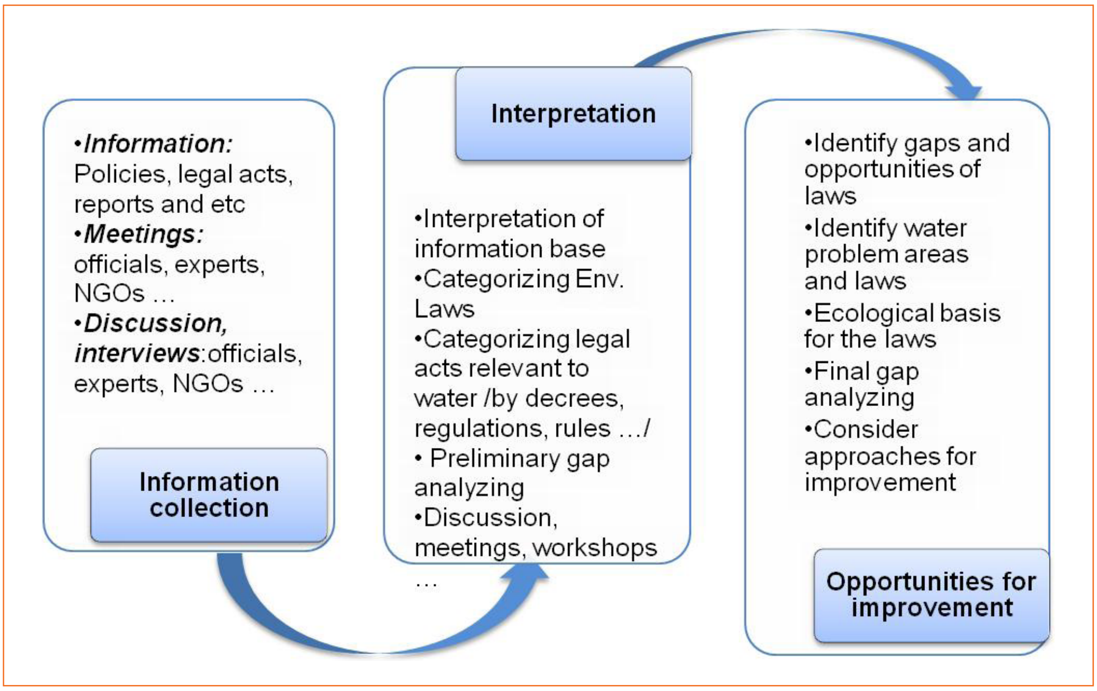

Figure 1. Steps for assessing the legal environment for water resources in Mongolia

Also, the questionnaires carried out by UN-DESA (United Nations Department for Economic and Social Affairs) and UNEP, UN Statistics, and GWP illustrate (Attachment 2) the inclusion and implementation of IWRM elements in Mongolian water legislation, developed by the "Status Report on Integrated Water Resources Management and Water Efficiency Plan" prepared from UN-Water.

Basing the questionnaires developed the diagrams illustrating the related issues to the IWRM elements and water legislation acts.

2. Water related legislations and policies

2.1. Laws and legislation on water resources

In Mongolia currently 56 laws regulate the protection of the environment, the proper use of natural resources and the restoration of available resources (see Annex 1). These laws are specified in environmental objects: air, water, land, forest, animals, mineral resources and others. Out of these there are seven laws that specifically regulate the effective use, protection, and restoration of water resources, water use fees and water supply (see Table 1)

Table 1. Laws related to water resources (as of December, 2010)

№	Name of law	Promulgated	Amended
1.	Water Law	2004-04-22	2005-01-27 2009-08-25
2.	Law on Springs	2003-11-07	
3.	Law on Fees for the Use of Water and Mineral Water	1995-05-22	2004-12-02
4.	Law on Meteorology and Environment Monitoring	1997-11-13	2003-01-02
5.	Law on Urban Water Supply, Sanitation Sewerage Use	2011-10-06	
6.	Law on Water Transportation	2003-11-28	
7.	Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas	2009-07-16	

The Water Law of 2004 serves as an umbrella law for water resources management. The Water Law introduced some principle changes, for example:

- it defines the mandates of the State organizations that are in charge of development and adoption of integrated water resources management plans;
- with regard to decentralization of water governance the law opens the way to engage citizens in local water management by introducing the concept of River Basin Councils and define their mandates.

In Article 1.1 the purpose of the Water law is stated as: "*… to regulate relations pertaining to an effective use, protection, and restoration of water and water basins*". And, in Article 2.1 it states "*The legislation on water shall consist of the Constitution of Mongolia, Law on Environmental Protection, Law on water supply of cities and urban settlement and utilization of sterilization facility, this law and other legislative acts issued in conformity with them*", which means that the Water Law is in accordance with the Constitution of Mongolia and other environment protection laws.

As mentioned above, a major change was made in the mandates of State organizations on water-related issues. In Article 12 it is stated that the Government agency in charge of water issues shall operate within the competence of the Minister in charge of nature and environment. The Article 12 is facilitating the Article 6.1 of Constitution of Mongolia "The land, its subsoil, forests, water, fauna, and flora and other natural resources are subject to national sovereignty and state protection."

As the main purpose of the Water Law is to regulate the effective use of water the Chapter 3 of Water Law regulates the relations of water utilizing and exploration. Depending on a purpose for water utilization the Water Law distinguishes "water consumers" and "water users":

- "Water consumers" are the citizens, economic entities and organizations who utilize water or the water environment for non-profit purposes such as drinking, household, herding and agriculture,
- "Water users" are those who use water or the water environment for profit in the industry and services sectors.

These two classifications, on the one hand fulfill the right to water, but on other hand, disappear the international environment principle "user pays", to protect the natural resource by implementing financial mechanism. It relates to the big amount of water use, such as farming and agriculture, which is classified as a "water consumer", not "water user".

For implementing the article on water use fee of the Water Law the Law on Fees for the Use of Water and Mineral Water was amended as follows,

- The water use fee for mining shall be calculated according to the cubic meters of water used (Article 6.1.3)
- Minimum and maximum fee limits of water use determined by water use purpose, depending on water resouce, surface or groundwater (Article 7.1)

From 2000, the mining industry is developing rapidly. But, due to the lack of control under the natural resources use and environmental law implementation, absence of necessary legal acts and good management its depleting natural resources, degrading the environment and ecosystem, which raises the need for new legal arrangements. The Government formulated policies to protect water basins and forest areas on 16 July, 2009 adopted the Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas,. Since this Law was enacted the Government has conducted surveys to see which licenses may be affected, which do not conform the law

According to the Water Law and other related laws, there must be developed 39 bylaws, norms, regulations within the powers of state organizations on water relation issues, which 29 legal acts were developed, adopted and exists according its legal frame. (Attachment1), 10 of them is not developed by the component authorities.

After promulgation of the Water Law the following bylaws were developed:

- River Basin Council Rule (Ministerial order of Environment No 187, year 2006),
- Regulation on Registration of Water Resources (Ministerial order of Environment No 269, year 2006),
- Regulation on Water Database, its recording (Ministerial Order of Environment No 180, year 2006)
- Form of Water Use Licence (Ministerial Order of Environment No 298, year 2006)
- Ecologic and economical value of water of Mongolia (Government Order No 47, 2008)
- Form for the registration of water point (Ministerial Order of Environment No 269, 2006)
- Surface and groundwater water infrastructure registration form (Ministerial Order of Environment No 269, 2006)
- Protection regimes for Special, Ordinary and Sanitary Zones of Reservoirs and Sources of Water Resources (Ministerial Joint Order of Environment and Health, No 51/57, 2009)

- The procedure for determining level of drought and water resources management (Government Order No 256, 2007)..

2.2. Laws and legislation on environment

Chapter 2.1 mentioned that 56 laws were in place in Mongolia related to environment management. The umbrella law of these laws is the Environment Protection Law, of 1995. In Article 3 of the Environment Protection Law lists the protected resources:

1. land and soil
2. underground resources and mineral wealth
3. water
4. plants
5. animals
6. air

Specific laws are formulated to protect these natural resources and to regulate the proper use of these resources ensuring the ecological balance.

Article 5 of Environment Protection Law states the State's environmental guidelines and principles as follows:

1. the creation of favourable environmental condition for people to live, work and rest;
2. the development of an ecologically sustainable economy and maintenance of ecological balance;
3. the provision of conditions for the proper and scientifically-sound use of natural resources;
4. public access to activities and decisions in respect of environmental protection and the use of natural resources.

All the state organizations that are involved in environment management must abide by the guidelines and principles stated in the Law and policy documents.

After its promulgation additional amendments were made to the Law in line with international environment principles, like:

- The right and duties of citizens in environment protection: to commence legal action against the person whose conduct may cause adverse environmental impact or jeopardist the enforcement of legislation on environmental protection; to establish non-Governmental organizations and capital funds for protection of the environment
- The "User-pays" principle, the compensation for pollution, exceeding permitted limits: fees for the use of natural resources reservers, and payments for discharging permissible levels of wasters and pollutants; and compensation must be paid for the use of natural resources which exceedd the limits permitted by contract and licence and for the discharge of wastes and pollutants in amounts exceeding permitted limits;
- Environmental information database, its recording: Article 7, Environmental Database was amended on 31 January of 2008 in Environmental Protection Law. The Article fully regulates the environmental information databes issues, including the type of database (data, mapping, graphic, written, video, audio), data inventory list (land and soil, mineral resources, water and mineral water, forest, plants, animal, air and air pollution, climate, natural disaster, toxic and hazardous chemicals, waste, special protected areas, legal acts, environmental

impact assessment, environmental policy and programs, environmental statistics reports, environment protection measures budget, human resource and environemtnal ogarnizations acting in the field, meta-data and others), the organizations in charge of collecting the datas, the durations, deadlined of submitting the datas, the responsibility of Environemntal Information Center, dissemination , use of datas, store and safety regulations.

- Economic incentives to protect the environment: the state shall reward citizens, business entities and organizations for the introduction or modern non-polluting and non-waste technology, progressive methods for environmental protection, the use and restoration of natural resources, and the reduction of adverse environmental impacts.

By the new amendment the citizens have the right to commence legal actions against entities, organizations, or citizens who are not complying with the environmental legislation (Environment Protection Law Article 4.12.), as opposed to previously when only Aimag or Soum Governors had that right.. This article reflects the implementation of the international environment principle "*participatory approach at all levels*".

2.3. Policy documents

Mongolia has developed a number of key policy documents to protect the environment (Chapter 1.1.). The Government of Mongolia has adopted the Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia on 31 January 2008, which under Mongolia's development priority number 5 states: "*Implement a policy, which envisages a set of integrated social, economic and ecological measures directed at protecting the environment, including efforts at protecting atmosphere, land, mineral wealth, water, forests, as well as fauna and flora; proper utilization of mineral resources; reducing the effects of desertification and droughts; cutting the emission of hazardous chemicals and radioactive waste; and improving waste management.*"

Within this framework the 'National Program on Water' was adopted on 20 May, 2010. Strategic objective 3 of the Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia's development priority number 5, refers to the legal status of the development and implementation of this National Program on Water. This Strategic objective 3 states, "*Create the necessary conditions for protecting and ensuring proper use of the water resources, preventing their shortage, and providing the population with water that meets health requirements. Implement a National Water Programme*". The purpose of the Programme, its implementation period, the results, and criteria are all within the National Development Strategy.

And, most of environmental programs and concepts are based on the State Policy on Ecology which was adopted on 26 December, 1997 by the Parliament Order 106. The implementation period of the Policy is determined in three stages:

- First period – till 2000 is to build the fundament for further sustainable development basing on ecology. During this period the government shall improve the legal environment, facilitate the control of law implementation, to establish natural resources use fees, to strength institutional capacity.
- The stage for the implementation of sustainable development strategy shall be started in 2001 to 2010. In this stage, the highest priority shall be given to the establishment of an ecological foundation for sustainable development by integration of the environment protection and economic policy implementation activities. Taking into account the specifics of the economic zones, core centers of development and a network of infrastructure shall be constructed and set

up in areas having rich natural potentials consistent with the environmental carrying capacity of sites. Also, the management for special protected areas will be improved, improvements on environment quality standards, monitoring, analyzing and licensing.

- In 2010 to 2020, the stage for the implementation of the national policy oriented on ecology shall begin. During this period, there shall be introduced organizational and business methods suitable to the environment within the dominating spheres of social life.

The Policy 3.7 determined the water resources related state policy: the national water policy shall be directed to the protection of the water resource, its quality, rational use and restoration and to the creation of a condition for its potential development. Also, the water use propose and maximum limit shall be established in order to improve the environmental and economic value of water resource. The technical and technology policy stated in 2.5.2, to study expedient methods and technology with an aim to improve water management and regulation, to meet the water quality standards, to sustainable use the water resource for energy production and cropland irrigation, to treat and re-use industrial waste water, to purify and soften natural water, to discover new sources of water supply, to protect soil from swarm-ness, to separate sewage slag and sediments from waste water and to fully disinfect polluted water.

The Parliament of Mongolia passed the renewed National Security Concept of Mongolia at its plenary session on July 15, 2010. The National Security Concept provided for the comprehensiveness of national security and has become the vital leverage of the state policy to realize national security in field of dependency, economic, home affairs, human security, environmental security, information security. The Article 3.5.1 determined the policy to prevent water scarcity:

- To strength water institutions, to facilitate the water controlling mechanism, to facilitate the drinking and industry sufficient and sustain water supply;
- To encrease water value, to determine the financial mechanism for water resource conservation;
- To research and explore the groundwater resources by state budget and submit the information to state water database, to strength water monitoring points;
- To protect groundwater resources, to establish protected zones, to prohibit industry activities in protected zones;
- To strength water resources management, to determine the exploitable ground and surface water resources, to use within determined water resources;
- To protect Khuvsgul lake, Khangai and Khentei mountain areas as National Park, and prohibit mining industry in these areas;
- To allocate surface water resources, to reserve snow and rain water, to build underground system to allocate reserved water to Gobi area;
- To use newest technology in industry water use, to minimize drinking water use in industries except food processing, to support a technology to re-use (recycle) water

3. IWRM Principles and Water Legislation of Mongolia

The International Conference on Water and the Environment (ICWE) in Dublin, Ireland, in January 1992 adopted the Dublin Statement, which in June of the same year was recommended by the world leaders assembled at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro to be made into urgent action programmes for water and sustainable development The recommendations for action at local, national and international levels are based on four guiding principles. These four principles became the basis of a holistic, comprehensive, and multi-disciplinary approach to water resources management worldwide. that cover environmental, economic, political and social issues and read as follows:

1. *Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.*
2. *Water development and management should be based on a participatory approach, involving users, planners, and policy-makers at all levels.*
3. *Women play a central part in the provision, management and safeguarding of water.*
4. *Water has an economic value in all its competing uses and should be recognized as an economic good as well as a social good.*

3.1. Principle 1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment

Under Principle 1 we may include the following understandings:

- Water policies
- Water quality controls
- Water supply management and protection
- Water planning and river basins
- Assessment of water projects and programs

3.1.1. Water policies

The State's water policies are defined by the Constitution of Mongolia, the Environment Protection Law of Mongolia, the Water Law and by the policy documents, such as 'National Water Program'.

The provision of the Constitution of Mongolia that says "*The soil, the bowels of the earth and other natural and mineral resources belong to the nation and are protected by the state*" unambiguously resolves the question of ownership of natural wealth. Thus, natural wealth including water resources is a national property. This approach is similar to that in most nations of the world. However there are a few countries where the local administration is owner of the local water resources or even individuals who own a given piece of land are recognized as the owners of the water resources on (or under) it. The referrenced provision of the Constitution of Mongolia finalizes the question of ownership of water resources and, it guarantees that water shall be used under strict control of the state, exclusively.[1]

The Article 16.2 of Constitution of Mongolia says that the citizens of Mongolia are guaranteed to enjoy the right to a healthy and safe environment, and to be protected against environmental pollution and ecological imbalance. By this, the State secures to save the nature and fulfill the safe living of their citizens. In Article 23.3 of Water Law states, "*A right of a citizen, economic entity or organization on land possession shall not entail to a right for water utilization on the land it possesses*", which seperates the land use right and the water use right enforcing the Article 16.2 of Constitution of Mongolia.

In order to raise the interest of citizens to protect the environment, and to provide incentives to entities Article 6.3 of the Environment Protection Law says, "*As provided by the law and treaty, citizens may own plants and forest planted and grown by their private fund , bred animals, water basins, lakes and ponds formed by accumulation of rain water on the land of their ownership and possession as well as economic entities or organizations on the land of their possession.*"

In 2005, the Parliament of Mongolia has adopted the Millennium Development Goals and Targets of Mongolia, which in Target 15states, "reduce the shrinking process of rivers and streams by protecting and rehabilitating their resources" and Target 16 says, "*reduce, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation*". As mentioned in Chapter 2.3, the Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia has been adopted through Resolution No 12 of the State Great Hural later in 2008. By this Resolution the Government of Mongolia was tasked to elaborate anew or renew National Programmes in line with the Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia, and organize the work for their implementation. Within this framework the 'National Water Programme' was developed and adopted focussing on reduction of water pollution, protection of water resources, supply of safe drinking water and strengthening water institutions.

The National Water Program will be implemented in two phases: the first phase or intensive development phase from 2010-2015, the second phase or sustainable development phase from 2016-2021. The strategic objectives of the Program are to strengthen water resources management, to regulate water use efficiency, to improve the legal environment of water resources management and water institutions, and build water management capacity.

Also, the regional policy documents are adopted at aimag levels to implement the National Programs and state policies. The regional policy documents are based on "Regional Development Concept" which was approved by Parliament Resolution No.57 in 2001. The concept defines the general policy on rural and urban development for the next 15-20 years. According to the concept Mongolia is to be subdivided into following four economic regions.

- Western region: Bayan-Ulgii, Gobi-Altai, Zavkhan, Uvs and Khovd aimags
- Khangai region: Arkhangai, Bayankhongor, Bulgan, Orkhon, Uvurkhangai and Khuvsgul aimags
- Central region: Gobisumber, Darkhan-Uul, Dornogobi, Dundgobi, Umnugobi, Selenge and Tuv aimags

By the 2010 all aimags are adopted their development programs, for Tuul River Basin, we can say:

1 Report on improvement of water economy management of Mongolia, Dr Z. Batbayar, National Consultant, Inception Phase of IWRM project in Mongolia, 2007

- "Ulaanbaatar regional development program" was developed and adopted by the Government of Mongolia on 2006. The Ulaanbaatar Regional Development Program includes the period of 2006-2015, Article 1.6.3 is related to water supply and development of sewerage system; to improve water treatment facility, to make renovation in water supply and water sewerage system technology from 2006-2010; and second stage is from 2011-2015 - to supply sufficient and clean water, to improve water treatment plant relating with city planning.
- Uvurkhangai Regional Development Program, was adopted on 21 December, 2006 by the Order of Citizen's Representative Khural, Target 5 of the current Development Program says, "to conserve water resource, to supply sufficient and clean water, to use a new technology on irrigation treating polluted water." The activities under this Target will be implemented, i.e., to renew the standard on drinking water use amount and agriculture water use, to use economic mechanism to conserve water, to improve water supply of 60 percent of pasture, to develop and implement water resources management planning, to renew water treatment plant in bigger centralized soums such as Arvaikheer, Khujirt and Kharkhorin, to define the chemical substances and resource of springs and mineral waters, to protect its resources by establishing special protected areas.
- Regional Development Program for Tuv Aimag was adopted on 27 March, 2007 by the Order of the Citizen's Representative Khural of Tuv aimag. The first stage is from 2008-2016, during this period will be improved the water conservation, to set accurate water use behaviour and under this target will be implemented the activities mostly focused on drinking water quality and to renew irrigation systems, pasture watering. The second stage is from 2016-2023 is to prevent from water pollution, and under this target will be implemented the followings: to conserve sources of mineral water, springs, rivers, to renew the sewerage system in some soums, to build water reservoir near of Kherlen and Tuul river in order to irrigate the agriculture land.
- Regional Development Program for Bulgan aimag was approved on 23 December, 2005 by the Order of the Citizen's Representative Khural of Bulgan aimag. The Development Program has two stages, the first stage is from 2006-2010, during this period will be implemented the followings: to improve water policy management and institutional set-up of aimag, to make the water inventory in order to research water quality, quantity, to improve drinking water quality, to install water metering in all water utilization, to renew or build new boreholes for irrigation and pasturing, re-use polluted water, to establish River Basin Council, to restore the damaged or changed river channels due to the mining industry. The second stage is from 2011-2020 and the target is to set-up effective water use, to prevent from water pollution, increase water resources in the Regional area, the activities under this target are planned to do: to develop and implement the water resources management planning in big River Basins, to renew the drinking water supply technology and equipments, to install the water metering in all water utilizations, to make the assessment on water pollution in Orkhon and Selenger River Basins, to establish human-made lake and to plant fishes and other water animals near of Erdenet Factory, to build big reservoirs collecting rain and snow water, to find the investment for the mentioned activities.
- Selenge aimag Development Program was adopted in 2007 by the Citizen's Representative Khural of Selenge aimag. The first stage is from 2007-2012, "to

prevent from water pollution, to set-up effective water use" is a target and activities planned under this target. For example, to establish River Basin Council, to develop and implement water resources management planning, to fulfil the responsibilities stated in Transboundary Agreement and to monitor the water quality with the Russian Federation, to supply safe and sufficient drinking water, to renew and establish new irrigation system basing the big rivers such as Kharaa, Eroo, Orkhon and Selenge. The second stage is from 2013-2021, and during this period is targeted to decrease human impacts or other natural impacts in water pollution, to conserve the water resources and its restoration.

- Arkhangai Regional Development Program was adopted in 2006 by the Citizen's Representative Khural of Arkhangai aimag. The Program has a two stages, the first stage is from 2006-2010 and the second stage is from 2011-2015,. But, the Targets on water resource conservation are not determined in the current Program.

Water quality monitoring

Article 6 of the Water Law states that the water monitoring network shall consist of regular functioning stations and guards that determine the level of water resources, variables of quality and pollution. But this part of the Water Law could not be implemented fully till today, due to the lack of professional management, the shortage of equipment of water monitoring networks. And, the main reason is absence of the Regulation which is stated in the Water Law, Article 6.2; "the State Administrative Central Organization in charge of nature and environment shall determine a number and location of water monitoring stations, guard posts, monitoring variations, methodology and programs and provide professional management". Today, the water monitoring networks monitor only levels of water, not a quality.

In 2003 by Government of Mongolia has adopted the Rule of Monitoring of Land and Soil use, its quality, which involved the monitoring criteria of water resources land. By the Water Law definitions the "water resources land means land areas composed of lakes, ponds, bottom of former lake, rivers, streams, springs, glaciers, glacial rivers". In absence of the legal arrangements, State organizations in charge of water and land use are developing and implementing in separate rules and regulations in water quality monitoring. It means that we need improve the pollution management.

The pollution is increasing rapidly with the urbanization, industrialization, population growth.. Many countries applied the following important environmental principles :

- Prevent rather than treat
- Apply the polluter-pays principle
- Apply realistic standards and regulations
- Apply water pollution control at the lowest level – the appropriate level may be defined as the level at which significant impacts are experienced. If, for example, a specific water quality issue only has a possible impact within a local community, then the community level is the proper management level. If environmental impacts affect a neighbouring community, then the appropriate management level is one level higher than the community level, for example the river basin level.[2]
- Balance economic and regulatory system -

2 Water Pollution Control – A Guide to the User of Water Quality Management Principles, UNEP, Water Supply & Sanitation Collaborative Council, WHO. 1997

Does our Water Law include the above mentioned principles?

Article 24 of the Water Law regulates the requirements for water utilization. Citizens, economic entities and organizations that submitted a request for water utilization shall fulfil some requirements, one of which is to have facilities for sterilizing waste water to a standardized level. Most of requirements are not fulfilled, but the water use right is issued by the competent authority. Due to the lack of facilities for treatment the polluted water within the standard limit, the prevention of water pollution is a just word in the Law. From the Figure 2 we can see how water quality and water pollution issues are included in water related legislation.

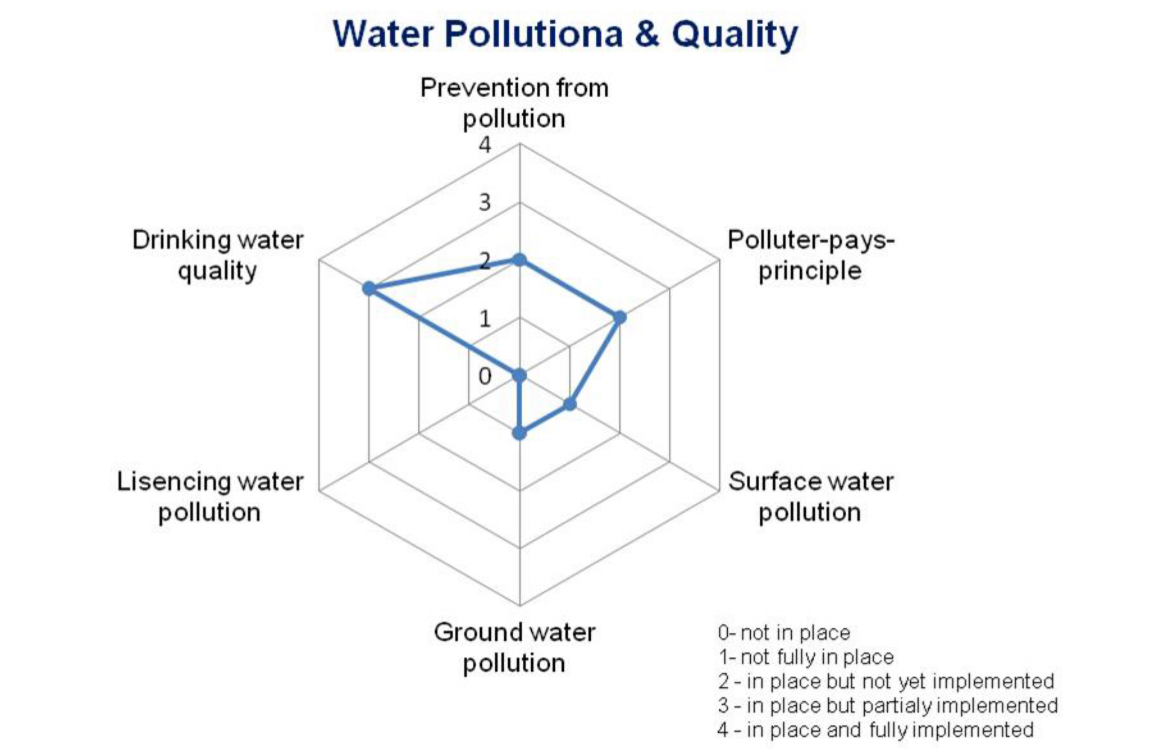

Figure 2. Water pollution and quality (inclusion in water related laws)

Chapter 4 of the Water Law regulates the protection of the water resources and their quality, habitat restoration. This chapter is preventing the water pollution by establishing special protected zones: sanitary zone shall set not less than 100 meters from banks of water reservoir area and ordinary protection zone shall be set not less than 200 meters. Specific activities are prohibited in these areas, such as construction of buildings and facilities, industrial digging, explosion, exploration and mining for mineral resources, cutting plants, trees, extracting sand or gravel, collecting plants for medical or industrial purposes or making facilities for washing animals or producing agricultural products.

The latest big step is a new Law on on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas to protect water resources and prevent water pollution. However, all these laws and regulations are addressing surface water pollution only and do not address groundwater pollution related to land and soil use, and its pollution.

To improve the legal environment for water pollution management, water quality there is need to renew all regulations, rules, standards which are related in. Most of the regulations were adopted during the period of 1992-1997, which could not fulfil today's urbanizations, population growth and industrialization.

The Water Law states that a citizen, economic entity and organization that polluting water shall be subject to a water pollution compensation fee, which will be set by law. But still, this law is absent. In order to apply the polluter-pays-principle in Mongolia was implement Tuul-21 project with the support of the Government of the Kingdom of the Netherlands during the period 2000-2003. The deliverables of this project was the draft law on Waste Water, and its fee. The draft law was introduced to competent Ministries, Agencies, but from State organizations were made the explanation that, there will be developed the Law on Prevention of Environment Pollution, and Pollution fee, not separated laws will developed such as Law on Waste Water and its fee. Just, today we are talking about "it is time to apply polluter-pays-principle", after more than 7 years.

According to the Report of Environment Central Laboratory (2007), 85% of the total surface water of Mongolia is "very clean and clean", 9%is "slightly polluted", 1% is "polluting" and 4% is "polluted and very polluted", and unfortunately this index is increasing rapidly day by day.[3]

Most of pollution is in downstream of Tuul river. This is directly related to industrial water use which the water use right issued while the requirements for water use are not fulfilled. During the meeting with the Environment State Inspectors from The State Specialized Inspection Agency, it was indicated that they are not satisfied with the current legal regulations. They check water use, water pollution, collecting all evidence, but due to the lack of legal arrangements in pollution-pays-principle no actions are taken.

The IWRM project team developed the standard on "Water quality, Effluent treated wastewater". From the international experience we can see, there are two kinds of standards:

- Effluent standards for treated wastewater
- Effluent standard prior sewerage system

In 1997, by the Three Ministerial Order of Infrastructure, Environment and Health was adopted the Standard of Industrial Waste Water, which is need the changes according to the international experience to set up the standard by the industrial sectors.

3.1.2. Water supply management and protection

From the report of Water Supply Expert we can see, the water usage in Mongolia can be divided by the following sectors:

- Drinking water (urban and rural)
- Industrial (mining)
- Agricultural (herding and irrigation)
- Green house, tourism

Mongolia is huge country, with a mix of urban and nomadic life. So, there is a need for specific water supply management and related legal regulations. In 2002 the Law on Urban Water Supply, Sanitation and Sewerage Use was adopted, which was limited only to water supply for urban drinking water. In the future, we must take into consideration the water supply in in the rural areas, specially, to fulfil the water rights of herders.

In Article 22.2 of the Water Law states that, water consumers have the right to a supply of water that meets quality norms, a right which is founded in the Constition

3 Surface water pollution of Mongolia, G.Chinzorig, 2009 year

of Mongolia, Article 16.2. Also herders are water consumers, but do not receive the drinking water of the specified quality.

Another issue is the water supply in ger areas. In order to supply the ger area with drinking water the Ministerial Order of Food and Agriculture, Environment, Finance was adopted in 2005 the General Regulation on Constructing of Engineering Designed Boreholes, its Equipment,, Financing, Use and its Owners.

But, by the Water Law the Soum or District Governor shall grant a license to consumers for drilling a borehole for ground water use. This license is issued without any control, limitation and without the decision of the competent authority. There are not any regulations for recording the information of such kind of boreholes.

Water supply management is closely related to water allocation management, which will be explained Chapter 3.3 under the Dublin Principle 4 ”*Water has an economic value in all its competing uses and should be recognized as an economic good as well as a social good.*”

3.1.3. Water planning and river basin

The competent authority which is in charge of the development, approval is stated by Water Law of Mongolia. The Government Agency in charge of water issues shall develop the National IWRM plan, State administrative central organization in charge of nature and environment shall submit the draft plan and the Government shall adopt the state water management plan.

To identify the responsibilities of the competent organizations which will participate in the development of IWRM plan, as there are many ministries, institutions as well as authorities must be involved in water resources management. To formulate this relation the Government of Russian Federation has adopted the Rule on Development and Adoption of IWRM plan, and its Further Changes, which clearly identify the responsibilities of stakeholders, the design of IWRM plan, the data collections, duration of discussion, adoption and the reasons of changes of approved plan.

Article 19.6.2 of Water Law of Mongolia states that River Basin Councils will develop the River Basin Water Management Plans, and submit the draft plan to the respective level Citizen’s Representative Khurals for approval and monitoring of its implementation. There will be raise and already faced the problem, which aimag or city’s Citizen’s Representative Khural will approve it? As, the river flows crossing territories of several aimag, soum, city boundaries.

By the Ministerial Order of Environment and Nature No 332 of 2009, the territory of Mongolia has been divided in 29 river basins. For example, the project is responsible to develop the IWRM plan for Orkhon and Tuul river basins. According to the existing Water Law which Citizen’s Representative Khural shall approve the draft plan for Tuul river basin:

- Tuv aimag
- Ulaanbaatar
- Uvurkhangai
- Arkhangai
- Bulgan
- Selenge aimag

For Orkhon river basin water resources management plan:

- Selenge
- Bulgan
- Orkhon

- Tuv
- Uvurkhangai
- Arkhangai
- Darkhan-Uul aimag

According to the Water Law the Government agency in charge of water issues shall develop the national IWRM plan and provide the river basin council with professional managanement. The Government agency in charge of water issues has the mandate to approve the River Basin's water resources management plan taking into consideration the proposals of the respective level Citizen's Representative Khurals'.

3.1.4. Assessment of water projects and programs

In most countries the water programs and projects are assessed for their impact on the environment and other national concerns. For example, the Australian Government, the programs and project must include economic and environmental considerations: considering that strong, growing and diversified economies enhance the capacity for environmental protection, conserving biological diversity and ecological integrity.

In 1998 the Law on Environment Impact Assessment was adopted, to regulate protection of the environment, prevention of the ecological misbalance, the use of natural resources, assessment of the environmental impacts and decision-making on the start of a project. In this context "project" is defined as the construction of new, or renovation or extension work of existing production or service facilities or any other activity toward the use of natural resources. So, the law is related only to some industrial activities not in programs which are implemented by government organizations with donors support.

By November of year 2009 there are more than 12 projects and programs are implementing in Mongolia with the financial support of foreign countries to protect the natural resources.

The Law on Coordination of Foreign Loan and Grant Aid was adopted in June 2003. The law defines the needs for certain loan or grant to be extended from the international financial institutions and donor countries, to receive and disburse loans and grants, collect repayments under loans and grants, to provide with appropriate conditions for accounting, monitoring and making payments, and as well as to regulate, in this connection, relations concerning rights, obligations and activities of central public administration bodies (i.e. ministries) and implementing agencies. But there is an absence of the assessment after the implementation of the project and program including the economic and environmental considerations.

3.2. Principle 2. Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels

The second Dublin Principle aims to realize real participation in decision-making processes and includes the following understandings:

- Vesting responsibilities for overall water management
- Conciliation of interest and consultation
- Concern for international issues (Chapter 4)
- Stakeholder participation
- Information sharing and dissemination

3.2.1. Vesting responsibilities for overall water management

The functional organization for policy making, water allocation, water management, and monitoring of users plays an important role in the implementation of a sustainable water development system.

The Chapter 2 of the Water Law the mandates of State organizations on water related issues are defined. In this Chapter only power of the governmental organizations are stated, not their duties related to water issues.

The State Great Khural shall define the state policy on water and to set fees for the use of water resources. While the Government shall organize and ensure implementation of the state policy on water, and adopt the national water resources management plan. Other powers related to water issues are specified in the Water Law for central government organizations, regional levels and River Basin levels.

The powers of state organizations are mostly related to water use right, to monitor it, to develop and submit any legislative acts, to organize the implementation of programs, to develop ecology-economic evaluation of water and others. And there is only one article is related to water allocation, but only after degradation of nature. It says, that we have not the water allocation policy and related legal arrangements. This gap we can found from Figure 3, which illustrates the participation of central government organization in water resource management planning, water allocation, to raise the fund for water resources management, problem solution and other powers.

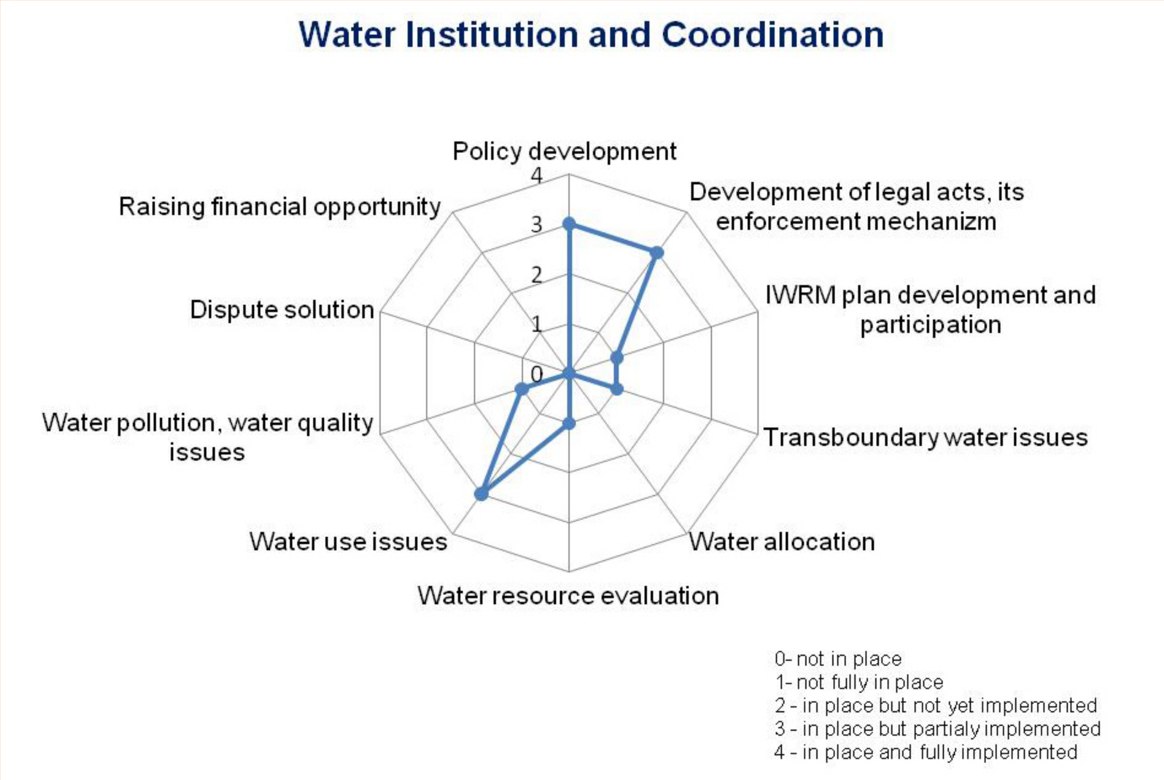

Figure 3. Water institutions and its coordination (inclusion in water related laws)

In 2008 the National Water Committee made an assessment on water institutions, their functions, and define the legal gaps. In this report the following gaps were identified:

There are more than 205 functions related to water issues that must be executed, 20 of these functions are executed by some organizations without any legal arrangements, 10 of the functions are not regulated by laws and not executed, the organizations are stated in laws but not implemented or implement by other organizations of 15 of functions, totally 64 functions are not executed and need a legal arrangements.[4]

In many countries water resources functions are executed at Ministerial levels, for example, the Water Law of the People's Republic of China states the Ministry of Water Resource shall execute water related functions, develop its policy, water use, water allocation, set up water use and pollution fees, to exercise the cross institutional performance. Such kind of proposal was made during the Inception Phase of the IWRM project in Mongolia by Dr Z. Batbayar, National Consultant. He says:"... there is need to improve the water sector, to change its status of Government agency in charge of water issues to state administrative central organization in charge of water. In this case, the water resources management issues can be discussed in higher levels. Or, there can be another approach to bring the Water Authority status under Prime Ministers responsibility, like as State Professional Inspection Agency.[5]

The National Water Committee has a power to regulate the cross sectorial relations between the Ministries, Institutions and agencies. But, due to the lack of capacity building, the National Water Committee cannot work properly, as they have only two staffs: the Secretary General and the Assistant to Secretary General.

Due to the lack of water experts at local levels there are challenges to implement Water Law. In Article 12.4.2 of Water Law stated, that Aimag and Capital City's Department of Environment shall maintain aimag and capital city water databank and submit data to the WA. But, the data received from local areas are incomplete or erroneous. The Ranger has a power to establish the Water Utilization Agreement with water users, but in some aimags and soums the agreements were established with the local Governors or State Inspectors. It happens because the rangers are not fully trained and do not recognize their powers.

There is exact example was found during the field trip among Tuul River Basin on September, 2009. The State Inspector of Zaamar soum, Tuv aimag established the agreement with water user, and the agreement was approved by Governor of Zaamar soum. To avoid such kind of illegal process, we can make an amendment to the Water Law; to give the power to River Basin Council.

From Kazakhstan experience, we can see that at all local areas work the governmental organization in charge of water resources, the leading government organization is the Water Resources Committee, which has a legal power as a governmental agency. The Kazakhstan institutional system for water resources management could be flexible for Mongolian situation.

3.2.2. Conciliation of interests and consultation

Governments are resorting to conciliation mechanisms and preventive strategies in order to manage water related differences and coordinate activities, with a view to achieve the several objectives, and satisfy the multi-demands.[6] To satisfy multi-demands the government shall intend to provide the common and national interest. The common and national interest expressed by the human right and freedom stated in Constitution of the country: the right to healthy and safe environmental, to be protected against

4 Report on legal regulation of water sector, currents situations of institutional arrangemenets, further necessary steps, National Water Committee, 2008 year

5 Report on improvement of water economy management of Mongolia, Dr Z. Batbayar, National Consultant, Inception Phase of IWRM project in Mongolia, 2007

6 The Dublin Principles for Water as Reflected in a Comparative Assessment of Institutional and Legal Arrangement for Integrated Water Resources Management, TAC background paper, 1999

environmental pollution and ecological imbalance. And, the interest is also related to water users who has or going to have the water use licenses.

Most of countries have legal arrangements for conciliation of interest; the Canadian Water Act establishes a system of agreements between government and water users, third party, if any. There are significant national interests are pointed, including responsibilities of the parties, the allocation of cost, terms of payment, the proportion of any compensation to be paid by each party, and water quality management agreements are also provided in.

The Water Law of China provides for the settlement of disputes among districts through consultations, with a spirit of mutual understandings and solidarity. If the consultation fails, the dispute will be referred to the next level of government. Projects cannot be implemented while a dispute is not settled, unless there is an agreement between the parties. The dispute can be referred to adjudication by either the administration or a court. The water use right cannot be issued till the dispute is solved.

Conciliation of interest, whether dispute solution settlements are not regulated by Water Law and also Law on Environmental Protection of Mongolia. Both laws regulate the monitoring of natural resources uses, not dispute resolution mechanisms. Because of the lack of such mechanism the common interests are not protected. For example: in downstream of Tuul river the water pollution exceeded the water quality standard, the national and common interests are touched: the environmental concern, need for ecologically sustainable development, right to clean water and etc. Altanbulag soum of Tuv aimag which is located in the middle of the Tuul river basin with a population of more than 3000, 182 000 pastures, and Undurshireet soum with a population of more than 2000, 133 000 pastures are lacking clean water. And, due to the groundwater pollution there is no possibility to use the land for agriculture.

Land use and water resource use are closely related and depending on each other, the dispute solution mechanism regarding water resources use could be followed and related to the Article 60 of Law on Land of Mongolia.

3.2.3. Stakeholders' participation

Participation of stakeholders in natural resources management development, implementation and in decision-making is one criteria of democracy. That is why one of the principles in integrated water resources management is to involve stakeholders participation in its process.

A common way to categorize stakeholders is:

1. *Water users/consumers*. Those who use water for household purposes and drinking are water consumers. And those who need a water-use permit according to the water law is a water user. It includes: farmers, utilities, industries, mining, local government, hydropower and so on. If citizens or entityies have a water use license, it means they are all water polluters, In most countries water user and water polluters are inseparable meaning.
2. *Governmental institutions*. The government is policy maker in water resources management, on the other hand it are water users/polluters. It is particular important to identify government institutions that have influence or impact on water management such as agriculture (land use), environment (land use, pollution management) so as to engage them in policy development.
3. *Civil society*. This category includes non-government organizations.

The above mentioned categories are stated in Article 19.4 of Water Law, to involve the stakeholders establishing River basin councils: A basin council shall consist of a chairman, secretary, 5-15 members representing local administration, environment department, agriculture and industry representatives, nongovernment organizations, citizens, scientists, researchers, environment rangers, professional inspection agency and professional organization on water issues.

Article 19 of the Water Law clearly defines that River basin councils shall be established in order to engage citizens in local water management for protection of water resources, its effective use and restoration.

But, in most established River Basin councils the group of stakeholders could not be represented within the water management principle, i.e., most of the members are Head of department, Governor of aimag or soum, Chairperson of respective aimag Citizens' Representatives ' Khural.

The Khovd and Buyant Rver Basin Councils were established by Ministerial Order No 59 of the Ministry of Nature, Environment and Tourism on March, 2009, with the financial support of World Wildlife Found. The stakeholders' involvement in this RBC could not met the requirements of the Water Law as stated in Article 19.4. The representatives from governmental organizations are dominating, there is not any representative from the water users, and only one water consumer-one herder is involved in the Buyant RBC. Figure 4 illustrates the stakeholders' involvement in established RBCs.

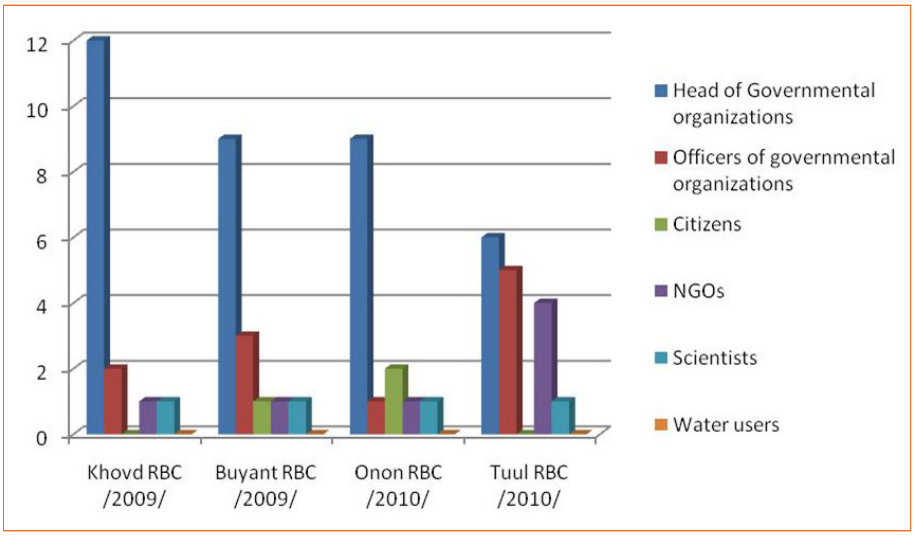

Figure 4. Stakeholder representatives in established RBCs

The "Strengthening Integrated Water Resources Management in Mongolia" project, tried to involve stakeholders in the Tuul RBC as defined in the Water Law. Stakeholders' involvement in the Tuul RBC is in accordance with the Water Law of Mongolia, there are representatives from governmental institutions, society, water users, scientist and representative from nongovernmental organization.

As, the RBC is established recruiting the stakeholders of water management, the power and responsibility must be defined clearly by the law and policy. How stakeholders are participating in water management through RBCs is illustrated in Figure 5. From the Figure 5, we can see that RBCs have not power in water use monitoring, water pollution management, water allocation and in transboundary water issues.

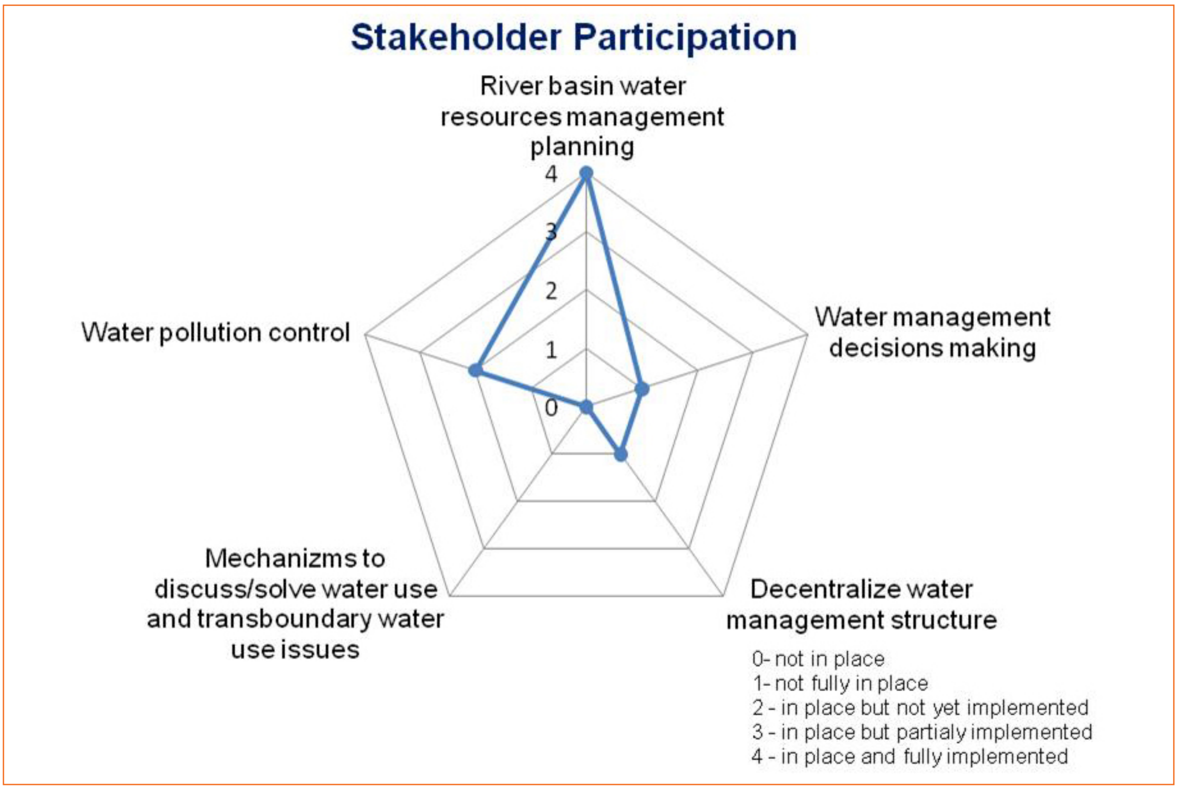

Figure 5. Stakeholder participation in IWRM

The chairperson and members of RBCs shall be appointed and dismissed by the competent authorities. After its establishment the RBCs are facing what is its status? The status of RBC is not clearly stated in the Water Law. According to the international types of river basin organizations it can be defined as, advisory committee, authority, association, council, commission, corporation, trust or federation. River basin organizations in Mongolia are defined as a Council - a formal group of experts, government organizations, NGOs with advisory power to the government. The "formal group" and "council" have no legal definition in Mongolia, not in the Civil Code (Sub-chapter Two, Types of legal persons) nor in other related Laws of Mongolia.

There is a financial challenge to facilitate and sustain activities by established RBCs. In the Water Law there is not any regulation related to financial mechanism for water management, nor how to finance the RBC.

So, Mongolia needs to reform its Water Law and other related legal acts as water reforms have taken place.

3.2.4. Information sharing and dissemination

It will be effective if any kind of information related to water management provided timely to whom who is developing water resources management plan, implementing and monitoring it. Therefore, it is necessary of information management function which clearly regulated by laws or bylaws.

Article 7 of the Water Law regulates relations raising with Water Databank and Cadastre, its recordings, what information will be collected, water facility indicators and others.

The Water Law enacts, that the water databank will be collected by administrative unit, i.e., by aimag or capital, soum and district, that could be complicated to use the information for river basin water management planning. The countries which are starting to implement IWRM, reforming their laws that the water information will be documented both in administrative unit and on river basins (Article 31, Water Code of Russian Federation).

As, Mongolia is making improvement in IWRM, it is necessary to make changes in information management-can be carried out by RBC, by whom who has power develop the River Basin Water Management Plan. Thus, the RBCs must be under-resourced both in terms of financial and human resources.

According to the Water Law the Nature, Environment and Tourism Department of the aimags shall collect water data and send these to the competent organization for the national water databank. The received data are not fulfilling the professional requirements to use it water management planning.

The information management process is enacting by the Regulation on Water Databank and State Water Cadastre, which was adopted on 2006 by Ministerial Order No 180 of Environment. The Regulation defines the types of data, its recording, its security and others. The security of the water data is classified as 'common' (open for everbody) use and 'secret' (restricted to somebody). The list of secret information must be defined by the Directorial Order of the WA, but the bylaw is not developed. As stated in the current Regulation, the terms of payment, the fee shall be established by Ministerial Order of Environment and Finance, which is still not developed either.

The data is available for governmental organizations, institutions, or state budgeted organizations free of charge. But, in practice, it is difficult to access the information.

The dissemination of the data is not regulated by laws or bylaws in Mongolia. In most countries the data are shared or disseminated through the electronical media of CDs and websites. The Water Code of Russian Federation says that the information on water bodies shall be available on the official website of the federal executive body authorized by the Government of the Russian Federation (Article 31).

3.3. Principle 4. Water has an economic value in all its competing uses and should be recognized as an economic good as well as a social good.

Water is not an ordinary commodity. Therefore, in most countries water belongs to the public domain, water use rights granted to private individuals, entities are protected under the national laws and bylaws.

This principle guides to define the economic value of water, water related services and its legal implications and includes the following understandings:

- Water Rights
- Water allocation
- Water market and water pricing

3.3.1. Water Rights

Water Rights can be divided into a "basic water right" and "water use right".

Basic water right – the people have as a consequence of primary legislation, which is permanent and not subject to any administrative process. The basic water right is stated in the Constitution of Mongolia (Article 16.2), and the Water Law (Article 22.2).

Depending upon a purpose for water utilization, citizens, economic entities and organizations shall be classified as a water consumer or water user. The basic water right is defined by the Water Law, stating that, water consumer has a right to water supply that meets quality norms, but not mentioned about sufficient and acceptable water. From this legal arrangement we can understand that there could be other legal arrangements for water users right for water use.

The basic water right is defined in the Constitution of Mongolia and the Water Law, but there is gap between other articles of the Water law, for example, Article 31.1 says that a water user shall maintain a volume of water resource required to sustain its natural and ecological balance. Principally, first satisfy the domestic need (basic water right), second, water resource must be retained in the river of aquifer for environmental or other sustainability-related downstream purpose. At least, the water use right can be issued by authorized organization. Basic water rights generally amount to a very small percentage of the overall water resources.

Another issue is the definition of “water consumers”, who have right to water supply: they are user who utilize water or the water environment for not profit seeking necessity such as drinking, household purposes, herding and agriculture. The amount of water usage in Mongolia was 324.2 mln.m^3 in 2010,17.8% of this usages was drinking water, 30.4 was for agriculture use and 23.7% herding, which means the two water consumers’ water usage stayed in the first places (Figure 6). From this water use we can find out that the definitions “water consumer” and “water user” are complicated which abusing the basic water right with water use right (Figure 7).

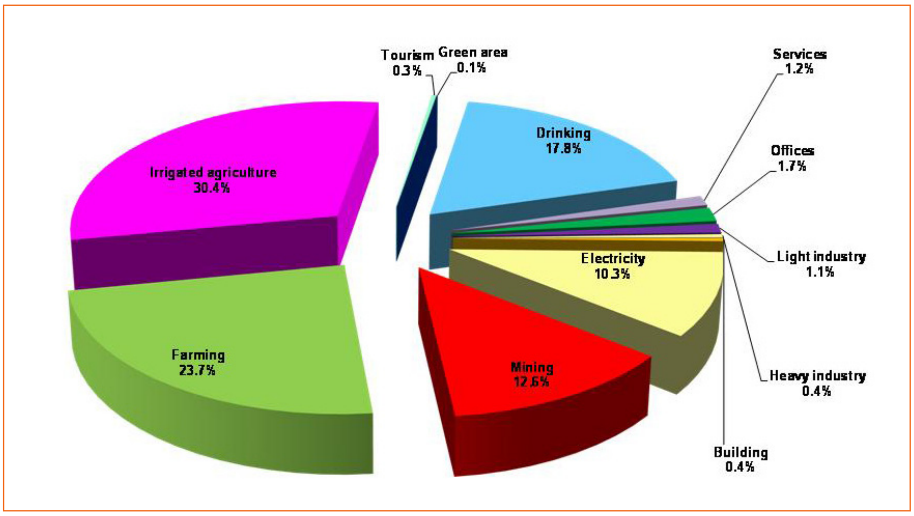

Figure 6. Water use by purpose (by year 2010)

Basic water right defined in primary legislation for human need, water use right decided through an administrative process, fulfilling exact requirements which are clearly defined in related laws.

Article 3 of the Water Law enacts issuing the water use right, defining the requirement, competent authority which is giving the decisions, licenses, contract and cancellation, etc. Depending the day water usage three competent authority shall exercise the power of making the decision on water use (Article 26, Water Law).

The requirements for water use were not categorized by its purpose and resources of water usage (from surface or groundwater), and the maximum amount of day water usage is not defined, which all these gaps are giving to water pollution, usage of water without control and of course, the decreasing the water resources (Figure 7).

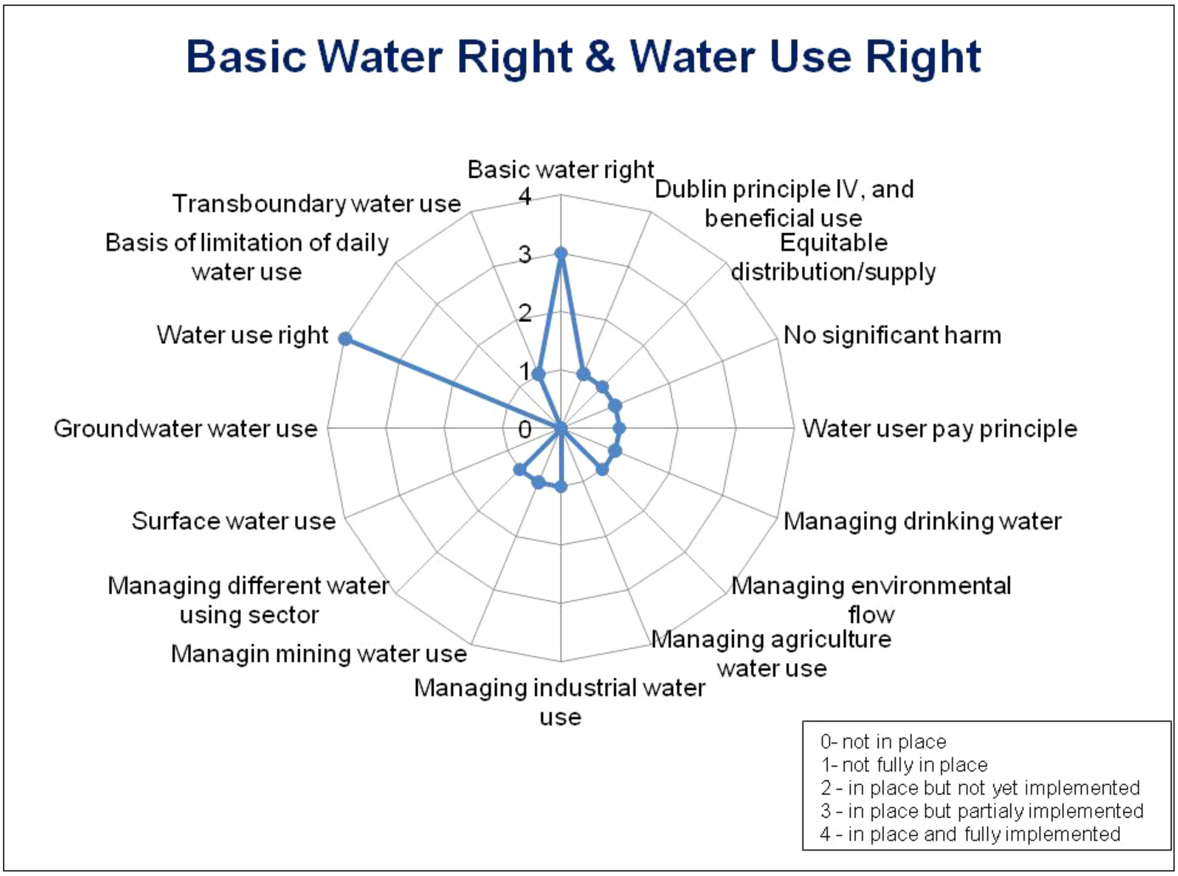

Figure 7. Basic water right & water use right (inclusion in related laws)

Today in Ulaanbaatar, many industries are issued with the water use right without fulfilling the requirements stated in Water Law. For example, beverage, wool, skin processing, building, road construction and others are using the water from the drinking water supply system, and polluted water flows directly to the public sewerage system as household waste water. The Head of Water Use Department of Water Authority said during the meeting, that the above flaw gives right to water users issue the water contract with water suppliers. Article 24.2 of the Water Law says that water pipes for industrial utilization shall be separated from pipes that provide water supply for cities, which in Ulaanbaatar city and in other urban areas this is not implemented.

According to the Water law, an economic entity, organization that utilizes water for mining operations shall not damage a river bank and its channel, and shall utilize water through pipes (Article 24.4). But, more than 31 rivers channels were changed with or without any decision and environmental impact assessment by 2008, which 7 of them was flowing through Tuul river basin.[7]

There is no concept or legal arrangements on water use during the dry, desertification seasons. The State Administrative Central Organization in Charge of Nature and Environment shall exercise the power to distribute and limit water use for industrial purpose or temporarily prohibit water resource utilization for water resources and habitat restoration in zones where its natural restoration cycle degraded based on conclusion of the professional organization. Most of countries are preventing from degradation of desertification by limiting the industry water use before its happening and vice versa in Mongolia.

7 Surface water pollution in Mongolia, G, Chinzorig, 2009

Water Law of China (Article 23, 24) regulates that, in areas where water resources are deficient, the scale of a city and the construction of industrial, agricultural, and service projects which consume a lot of water shall be restricted. The local government is responsible for the comprehensive water use and allocation, and the state shall encourage the collection, utilization in case of water resources are deficient. This legal regulation is preventing from degradation in water deficient areas, and further measures to be taken.

3.3.2. Water allocation

There are three incorporating principles to manage water allocation: beneficial use, equitable distribution and no significant harm.

Chapter 5 of the Water Law of China regulates the relations of the allocation and economical use of water resources. The competent government organization is responsible for macro-allocation and its medium and long term planning, water allocation plans and preliminary plans for water distribution under drought and emergency conditions. And the most important regulation in this law is that, the water allocation must be made basing the predicted annual volume of in-coming water,

From the water rights we can see that the legal arrangements for water allocation could not fully stated in the Water Law, more clear picture is shown in Figure 8. From here we can see that the three principles of water allocation are not included in Water Law of Mongolia.

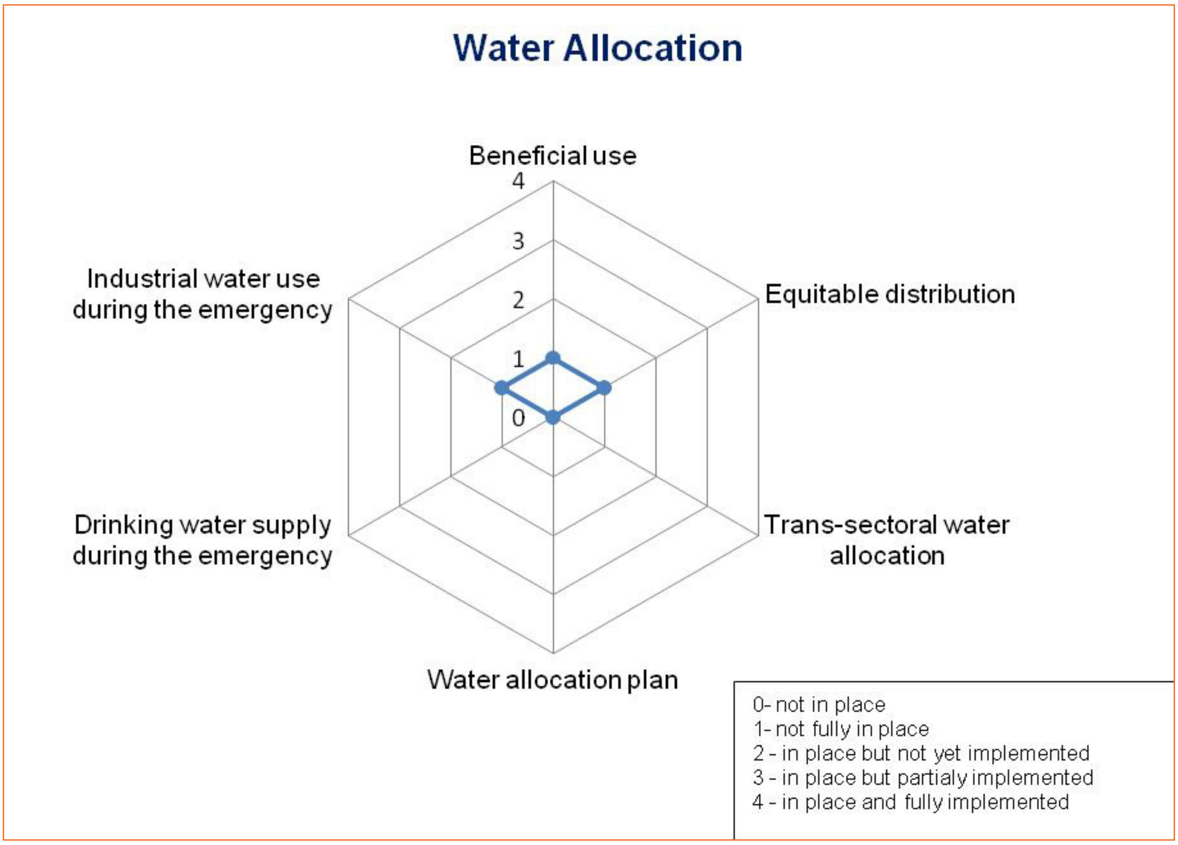

Figure 8. Water allocation (inclusion in related laws)

In the sub-chapter on water rights it was mentioned that The State Administrative Central Organization in Charge of Nature and Environment shall exercise the power to distribute and limit water use for industrial purpose or temporarily prohibit water resource utilization for water resources and habitat restoration in zones where its natural restoration cycle degraded based on conclusion of the professional organization (Article 11.1.6 of the Water Law). Most of the countries are preventing from degradation of desertification by limiting the industry water use before its happening and vice versa in Mongolia.

Water allocation concept is first, human need, second environmental reserve then industrial water usage. But, currently, Mongolia has not water allocation concept or plan.

Water user can apply for amount of water how much they want, there are no criteria for daily water use based on the river daily flow and etc. In some countries, for example, China is limiting the daily water use, in case of exceeding this limitation the fee will be increased (Article 49, Water Law of China).

The mining sector is rapidly developing in Mongolia, that in 2009 there were made several amendments in Water Law regarding the water use. The new arrangement says, the water use agreement shall be issued for 30 years and is extendable for another 20 years – any water discovered with investor's funding shall be allowed for only project use, if the approved water resource can fulfil this project's water usage. Which means, if some interested party will apply for water use in this area, the water use right will not be issued. The equitable distribution principle of water allocation is fallen in Mongolia (Figure 8).

To transfer of the water rights to the interested party is prohibited by Water Law. In Water Law of Russian Federation (Article 19) enact the right to transfer the water use license to the third party, and procedures, requirements are all clearly defined.

3.3.3. Water market and water pricing

Many countries have defined the principle to set up of water pricing, for example the Water Law of China (Article 55), says that the price of water supply shall be fixed in accordance with the principle of compensating for the cost, gaining reasonable benefits, paying good money for good quality and fair sharing of the cost.

The Law on Fees for Use of Water Resources and Mineral Water is to regulate the fees for the use of water and mineral water as well as procedures on paying these fees to the State budget. The law sets the water use fee, but does not include the principles of setting up the fees, expenditure of collected fees. The water user himself will calculate the amount of water use fee, and according to this calculation the fee will be collected and deposited in the local state budget (Article 9.2The Law on Fees for Use of Water Resources and Mineral Water).

As we are talking about water use fees, there is need to raise the "polluter-pays-principle". Acoording to Article 30 of the Water Law of Mongolia, a citizen, economic entity and organization that is polluting water shall be subjected to a water pollution compensation fee and the amount of compensation shall be set by law. But, this regulation is not implemented till now, as the law to set the amount of fee is still not developed. There is a big difference between "fee" and "compensation" . In most countries who apply the polluter-pays principle, the polluter pays a fee for water pollution. If they exceed the norm or standard for polluted water they shall pay compensation. The fee and compensation for water pollution could be regulated according to the Article 47 of Environmental Protection Law of Mongolia.

Water use fees shall be determined by the government within the limits, and mineral water use fees shall be determined by the Citizens' representatives' Khural of the respective Aimag or the Capital City within the limits set in The Law on Fees for Use of Water Resources and Mineral Water.

As mentioned above the collected fees are not allocated for the management of water resources, but just flow back into the local budget. So, further there is need legal arrangements to allocate the collected fees from water use or water pollution for water resource management financing, restoration and protecting the water resources. Figure 10 shows the financial arrangements for water resources management, which there are lack of investment for water institution, principles of water pricing, allocation or expenditures of collected fees and etc.

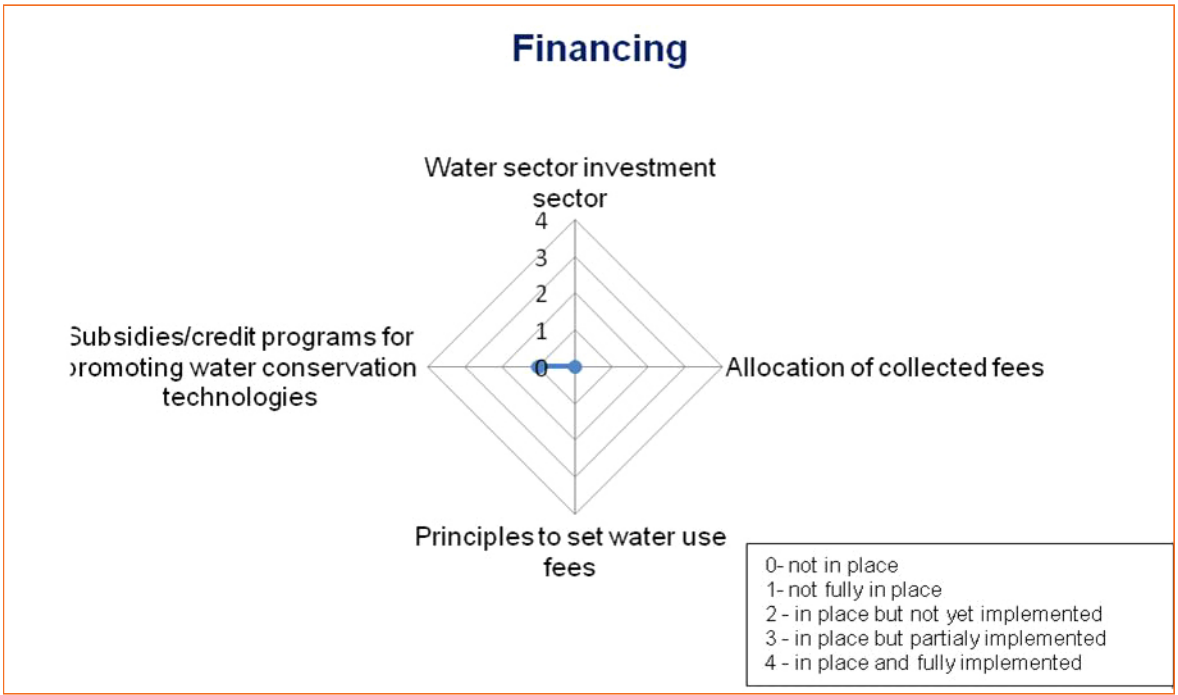

Figure 9. Economic and financial instrument (inclusion in related laws)

From international experience, for example the Law on Water Pollution Control of Taiwan, the collected fees from water pollution shall be spend for improvement of drinking water quality, to invest into water treatment plant, to improve the water pollution monitoring system, to test or develop new technology for waste water treatment, and the administrative expenditure related with all these activities will not exceed 10% of all collected fees (Article 11).

Mongolia has adopted the Law on Reinvestment of Natural Resource Use Fees for Protection of the Environment and Restoration of Natural Resources in 2000. The law defines the percentage and extent of fees paid for natural resource use to be applied for the protection of the environment and the restoration of natural resources. 35% of the collected fees shall be spent for restoration and protection of water resources (Article 4.5). The law never was implemented after its adoption, as the government shall not exercise its power on establishing regulations governing the establishment, expenditure and reporting of the part of fee revenues.

4. Transboundary water resources management and international water law in mongolia

4.1. Transboundary water agreements

There are 263 watersheds that cross the political boundaries of two or more countries. These international basins cover 45.3 percent of the land surface of the earth; affect about 40%of the world's population (Wolf et.al 1999).

Mongolia shares the following international basins with its neighbours:

- Yenisey (Mongolia and Russian Federation): 327 900 km^2 of basin area and the 18. 82 percent of Mongolian territory, Selenge, Onon rivers, Khar Us, Ubs lakes
- Amur (Mongolia, People's Republic of China and Russian Federation): 190 600 km^2 or 9.6 percent is Mongolian territory of watershed. Selenge, Onon, Bulgan, Kherlen rivers and Khalkh river, Buir
- Khar-Us Lake (Mongolia, Russian Federation and People's Republic of China): 179 300 km^2 or 96.81 percent of total area is located in Mongolia. Khar-Us, Ubs lakes

Mongolia has signed trans boundary agreements to protect, utilize and prevent from the pollution the above mentioned international river basins with the governments of the neighbouring countries: the Russian Federation and the People's Republic of China.

The Agreement between the Government of Mongolia and the Government of the Russian Federation on the Protection and Utilization of Trans boundary Waters was signed on 11 February, 1995.

On 29 April, 1994 the Agreement between the Government of the People's Republic of China and the Government of Mongolia on the Protection and Utilization of Trans boundary Waters was formalized.

The established Agreements included the international principles, rational utilization of the trans boundary water based on equality and mutual benefit.

The Agreement between Mongolian and Russian Government on trans boundary waters defines the following fields of cooperation to protect and utilize the transboundary waters:

- To prevent from pollution and rational use of trans boundary waters in order to fulfil the environmental flow of trans boundary waters;
- To investigate the trans boundary water resource, its quality, biology, water chemistry;
- To exchange the information on flood, industrial calamitiest, and other information within the framework of the cooperation;
- To prevent from pollution and to monitor the water quality;
- To work jointly in the field of the protection of fishes and birds in the trans boundary waters, and to protect the natural environment for migratory birds.

Therefore, to implement the following cooperation fields there mentioned several activities to be developed and done by two Parties: to develop the concept on protection, rational use; integrated methodology on monitoring; monitoring points; scheduled monitoring program; and to define the environmental flow in order to allocate the trans boundary water for water utilization; develop the norms and principles for water utilization and etc.[8]

The Agreement between Mongolia and People's Republic of China clearly defines the rivers and lakes under this agreement. The trans boundary waters include the Khalkh, Kherlen, and Bulgan rivers and Buir lake as well as the streams and other water that straddle or rest on the boundary line between two countries.

For the purpose of protection and rational use of trans boundary water, the Parties conducted the cooperation fields, as to investigate and survey of dynamics, resources and quality of boundary waters, monitoring and reduction of pollution of the trans boundary waters, protection of aquatic animals and others.

Article 5 of the Agreement states that the Parties will jointly work out technologies for the breeding and protection of fish resources in Buir Lake, and agreed to hold separate consultations on the issue of fishing in the Lake.

In order to address the agreed issues the Parties shall establish a Joint Committee on Trans boundary Waters. The Joint Committee shall discuss the implementation of the Agreement and matters related to trans boundary water issues.

It is difficult to evaluate or assess the implementation of signed Agreements on Trans boundary Waters, as in both Agreements say that Parties may utilize freely the results of the cooperation conducted and the data and technological information exchanged according to the Agreement. However, neither party shall transfer them to a third party unless permitted by the other party.

4.2. International water law and Mongolia

In 1997 the UN Law on the Non-Navigational Uses of International Watercourses was adopted by nations and countries may now sign and ratify agreement. The purpose of this law is to protect, preserve and manage the uses of watercourses and their waters (Article 1.1). The duties of countries are identified, including:

- duty to cooperate,
- duty to exchange data and information;
- no harm principle;
- duty to inform on planned measures;
- duty to protect and preserve the ecosystems;
- duty to participate in a joint management system;
- duty to take measures to prevent harmful situations and to take action during emergency situation;
- duty not to discriminate between citizens and foreigners in granting access to court;
- Duty to settle disputes peacefully and etc.

Till now there have been few ratifications and the Convention has not yet entered into force (Article 36). The Assembly took action on adoption of the Convention by 103 votes in favor to 3 against (Turkey, China, Burundi) with 27 abstentions. And the

8 Article 3, Agreement between the Government of Mongolia and Government Russian Federation on the Protection and Utilization of Transboundary Waters

present Convention shall be open for signature by all States and by regional economic integration organizations from 21 May 1997 until 20 May 2000 at UN Headquarters in New York. By 1 June 2010 there was not any action taken by China and Mongolia, one of who abstained to vote.

Mongolia is one of who abstained to vote for the Convention, the Russian Federation voted for it, People's Republic of China voted against and the statement was made "why". The representative argued: "there were obvious drawbacks in the draft convention. First, it failed to reflect general agreement among all countries, and a number of States had major reservations regarding its main provisions. Secondly, the text did not reflect the principle of the territorial sovereignty of a watercourse State. Such a Stat had indisputable sovereignty over a watercourse which flowed through its territory. There was also an imbalance between the rights and obligations of the upstream and downstream States. China could not support provision on the mandatory settlement of disputes which went against the principles set out in the UN Charter. Government of China favored the settlement of all disputes through peaceful negations. Accordingly, China would vote against the draft resolution to which the draft convention was attached (UN General Assembly Press Release GA(9248)).

The reason for abstention of Mongolia could not be found from official websites, related sources and press releases.

According to the international trans boundary water law in the trans boundary agreements countries must define the duties and responsibilities of riparian countries. In the Trans boundary Agreements signed between two neighbouring countries, the duties, responsibilities and rights of riparian countries were not defined. For example: allocation of transboundary water baed on the riparian country's ecological and socio-economic needs, mechanism of problem solution and so on. Aaron Wolf is Associate Professor of Geography at Oregon State University's Department of Geosciences, and Director of the Trans boundary Freshwater Dispute Database mentioned in his research paper: "Inclusion of Information sharing, monitoring and conflict resolution are in the past century's treaties. There has been a broadening in the definition and measurement of basin benefits, co-riparian has focused on water equitable allocation, rights-based approaches... "[9].

From the first point of view, it seems that Mongolia has not any disputes with two neighbouring countries regarding the trans boundary water resource uses. But, conflicts are there to share trans boundary waters to allocate it, based on the ecological and socio-economic issues. For example: Mongolian side still cannot negotiate to allocate Selenge river with Russian side.

If Mongolia will ratify or accept the UN Law on the Non-Navigational Uses of International Watercourses, the negotiation could be made based Article 5 and 6 of the Convention, the factors relevant to equitable and reasonable utilization. The climatic, ecological and socio-economic needs of the three international watercourses are essential for reasonable water utilizations.

Two neighbouring countries Russia and China have negotiated the "Joint Comprehensive Scheme on Amur and Argun Rivers" and since 1956 are conducting research work on Amur River Basin. From 1962 they focused on water infrastructure and suggested the development of four reservoirs, and the possibility of water transfers. The cooperation of the two countries collapsed till 1986, from which year the new agreement was signed by China and USSR to resume the Joint Comprehensive Scheme. After long negotiations they finally declined to approve the document, nevertheless all

9 Sharing waters: Post-Rio international water management, Meredith A Giordano and Aaron T. Wolf, 2003

proposed dams are included in the official list of future hydropower construction sites in Argun river. In 2007 the Chinese Ministry of Water Resources called upon Russian side to revive cooperation on water management and start the implementation of the Joint Comprehensive Scheme.

Our two neighboring countries are already taking action on trans boundary water equitable and reasonable utilization. What actions made from Mongolian side in this matter with two countries?

The field trip report of the project unit (Western part of Mongolia in 2009) mentiones about the Bulgan River. The Bulgan river flows through one of the branches of Mongol Altai Mountain and Bayan-Ulgii and Khovd aimags, and then crosses the boundary into China. There is no equitable utilization before crossing the border, just across the border the Chinese constructed a hydropower plant. But, Bulgan soums of two aimags have no electricity. Local people argued that is there any method to ask the electricity from Chinese side, as we are flowing the river without any use. The Bulgan River is clearly mentioned, that it is a trans boundary water in the Agreement between the Government of the PRC and the Government of Mongolia on Protection and Utilization of Trans boundary Waters. The agreement only regulates the protection of water resources, monitoring of pollution, technology and information exchanging, or joint research, and symbolized the regulation on water utilization (Article 4).

From the international water law theory, the benefits of cooperation on international waters are identified in four different ways (Sadoff and Grey, 2002): [10]

- *Benefits to the river:* Cooperation between riparian countries allows better management of ecosystems, which will provide benefits to the river, underpinning all other benefits that can be derived.
- *Benefit from the river:* Efficient, cooperative management and development of trans boundary rivers can yield real and direct benefits, for example increased food production and energy generation.
- *Reduction of costs because of the river:* There are existing tensions between riparian countries and those tensions will generate cost. Cooperation on trans boundary river basin management will reduce those tensions and thus costs.
- *Benefit beyond the river:* Cooperation on rivers may strengthen the cooperation and trade between riparian states and even economic integration, which may yield much greater benefits.

Sadoff and Grey (2002) suggested that when riparian countries negotiate the equitable and reasonable utilization of trans boundary river basin, they should not solely focus on the allocation of water, but they should also focus on equitable sharing of the benefits derived from the river.

Therefore, it is time to improve the agreement on trans boundary water utilization and protection with other riparian countries, including international trans boundary water law concepts.

When Mongolia ratifies or accepts the UN Convention, Mongolia shall have right to utilize the watercourse with the view to attaining optimal and sustainable utilization thereof and benefits therefrom, of course taking into account the interest of the other watercourses States. The right for utilization it means the obligation, it is Article 7-obligation not to cause significant harm.

10 Legislation of trans boundary water resources, Pieter van der Zaag, Frank Jaspers and Joyeeta Gupta, UNESCO-IHE, 2010

The Rio Declaration on Environment and Development (Principle 16) will fulfill Article 7 of the UN Convention, which says "National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment".

In 1992 Mongolia fully accepted the Rio Declaration, that forcing to implement the "polluter-pays-principle".

4.3. The Convention on Wetlands of International Importance especially as Waterfowl Habitat and Mongolia

The Convention on Wetlands came into force for Mongolia on 8 April, 1998, presently has 11 sites designated as Wetlands of International Importance, with a total surface area of 1,439,530 hectares, including:

No	Site	Date of designation	Region	Surface area
1.	Ayrag Nuur	13/04/99	Khovd aimag	45,000 ha
2.	Har Us Nuur National Park	13/04/99	Khovd aimag	321,360 ha
3.	Lake Achit and its surrounding wetlands	22/03/04	Bayan-Ulgii, Uvs aimags	73,730 ha
4.	Lake Buir and its surrounding wetlands	22/03/04	Dornod aimag	104,000 ha
5.	Lake Ganga and its surrounding wetlands	22/03/04	Sukhbaatar aimag	3, 280 ha
6.	Lake Uvs and its surrounding wetlands	22/03/04	Uvs aimag	585,000 ha
7.	Lakes in the Khurkh-Khuiten river valley	22/03/04	Khentii aimag	42,940 ha
8.	Mongol Daguur	08/12/97	Dornod aimag	210,000 ha
9.	Ogii Nuur	06/07/98	Arkhangai aimag	2,510 ha
10	Terhiyn Tsagaan Nuur	06/07/98	Arkhangai aimag	6,110 ha
11.	Valley of Lakes (Boon Tsagaan Nuur, Taatsiin Tsagaan Nuur, Adgiin Tsagaan Nuur, Orog Nuur)	06/07/98	Bayankhongor aimag	45,600 ha

The Convention mission is "the conservation and wise use of all wetlands through local regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world".

The administration authority in Mongolia is the Ministry of Environment, Nature and Tourism, and several national focal points are designated in charge of daily contact (Mr. A. Namkhai, Department of Special Protected Area); scientific and technical review panel (Ms. Choikhand, Head of International Department) and absent of two focal points who are in charge of communication, education and public awareness.

Every three year contracting parties meet during the Conference of the Contracting Parties (COP) to receive national reports on the preceding triennium, approve the work programme and budgetary arrangements for the next three years, and consider guidance for the Parties on a range of on-going and emerging environmental issues. Last COP was held on 2008, and the National Report of the Implementation of the Ramsar Convention on Wetlands of Mongolia was submitted.

From the report we can see the clear understanding how Mongolia is implementing the Ramsar Convention in Ramsar sites. The report developed under 4 goals:

1. The wise use of wetlands
2. Wetlands of international importance
3. International cooperation
4. Implementation capacity

From the Mongolian report found that the most of goals and strategies are partly implemented or not fully implemented, for example:

- Integrated policy and planning on the conservation, identifying priority wetlands where restoration would be beneficial, and actions to prevent (strategy 1.4, 1.5, 1.6)
- Monitoring the condition of Ramsar sites (strategy 2.4)
- Collaboration of institutions, both in international and national level (strategy 3.1)
- Sharing of expertise and information (strategy 3.2, 4.9)
- Public participation, recruitment of stakeholders (strategy 4.4)
- Development of capacity building (strategy 4.8, 4.10)

Ramsar Advisory Mission is a given to assisting member States in the management and conservation of listed sites whose ecological character is threatened. Mongolia does not express its interest to receive this mission to solve the problem in prevention the wetlands. In some cases, the recommendations of Ramsar Advisory Mission reports have provided the framework for financial assistance from the Small Grants Fund and external support agencies.

One of the most supporting activity is a CEPA (Communication, Education, Participation and Public Awareness), which is a tool that should be used at national, regional and local levels, involving all sectors of society from key decision-makers, to the public at large, wetland users, the media, as well as teachers and schoolchildren. The CEPA was not implemented in Mongolia. It could be implemented by the established River Basin Councils of the Ramsar sites.

The main reason of the above mentioned poor implementation of the Ramsar Convention on Wetlands is the institutional setting, the lack of legal arrangements in the power and responsibility of the Water Authority.

4.4. World Heritage Convention

Mongolia has accepted the World Heritage Convention on 02 February, 1990. The Uvs Nuur Basin was registered as world natural heritage in 2003.

The following sites have been submitted to the tentative list:

- Govi Gurvansaikhan Dessert Fossil (1996)
- Great Gobi Desert (1996)
- Khovsgol Lake Tsaatan Shamanistic Landscape (1996)
- Mongolian Sacred Mountains (Bogd Khaan, Burkhan Khalduun, Otgontenger) (1996)
- The upper Tsagaan gol Comples (2009)

In 2005, the World Heritage Center, Ministry of the Environment and Nature and Mongolian National Commission for UNESCO co-organized the international seminar to develop the management plan for the conservation of the Uvs Nuur Basin. But, currently the development of the plan is frozen.

Such kind of planning activities can be implemented by the River Basin Councils, as by Water Law the River Basin Councils are in charge to develop the management plan in their basins, or somehow the River Basin Council can be recruited in the development of the planning.

5. Conclusion and further amendments to water law

During the development of this technical report several meetings were organized to discuss the current environment for water resources management with water sector experts, state inspectors and policy-makers. At the meetings gaps and overlaps in the water legislations were identified. For example:

- Unclear definitions of the terminologies, overlapping with other legislation
- River basin's, and other related management instruments are not defined
- Incomplete regulation on water use related relations
- Powers, liabilities are not completely stated or overlapping
- No dispute resolution mechanisms
- Lack of safeguarding mechanisms against pollution, droughts, and floods

In order to improve the legal environment for IWRM the following proposals have been developed.

5.1. Legal terminologies

There is an urgent need to improve and update the legal terminologies due to the industrialization, water use and pollution. The following examples are mentioned:

The Environmental Protection Law of Mongolia defines the term of "water"-surface and ground water resources including rivers, springs, ponds, mineral waters and glaciers, as well as natural and manmade water sources within the territory of Mongolia (Article 3.2). But the Water Law defines the term "water resources land"- land areas composed of lakes, ponds, bottom of former lake, rivers, streams, spring, glaciers and glacial rivers (Article 3.1.3, Water Law).

In the above mentioned definitions, "mineral water" was not included in water resources land. And, the understanding the "wetland" is absent in all water related legislation. The Ramsar Convention defines a wetland as a body of surface water.

The term "water environment" is used several times in the Water Law but no definition is given, however the meaning seems to be the same as a "water resources land". For examples, Article 12.2.8 "... to make professional evaluation on temporary or partial alterations of river channel, regulation of river discharge and utilization of *water resources land*", and the Article 14.1.4 states "... *water environment* use, protection of water quality, prevention from water disasters and elimination of damages". From these two articles it is clear that it refers to water bodies. There is a need for comprehensive terms and definitions.

The Russian Water Code clearly defines the terms, classifying the water bodies by surface and ground water bodies, which mention all types of water bodies including, watercourses, bogs, natural water outlets, flooded pits, snowfield,etc.

Due to the Baganuur coal mining the Khujirt, Khutsaa Rivers, Nuurent mineral water, and wetlands around these areas completely dried up.[11] According to the existing Water Law "what is wetland?".

The concept of renewing the Water Law in 2004 was the inclusion of water resources management and its planning. Article 3.1.12 of the Water Law defines "water

11 Regional Development Program of Ulaanbaatar, Governmental Order No 197 of Mongolia adopted in 16 August, 2006

management plan" as a policy document for effective use, protection and restoration of water. The "plan" must be integrated coordination all institutions, as well as there is a question "is it a policy document?" The Global Water Partnership defines as following "National Water Resources Integrated Management Plan sets out the national strategy that identifies the priority steps that must be taken to reform the water management system to meet IWRM principles. It may suggest changes in national policy, the legislative framework, financing structure, organizational framework, and a range of management tools. It should set up a sequence of actions over a specific time frame to transform existing practice to more sustainable ones". From this international definition we need to change the definition to the correct manner.

Depending on current water use there is need to reclassify the water user and water consumer; to change the agriculture and herding water use to water user in stead of water consumer. Furthermore, there could be monitor and set the water use fee for these categories.

In order to implement the developed IWRM plan amend new terms in the Water law and other legislative acts: water depletion, adverse impact of water, water polluter and others.

5.2. Powers and responsibilities of governmental organizations and River Basin Organizations

For success IWRM plan development and its further implementation to improve the power of the WA. The following powers are necessary for Water Authority:

- To approve river basin water resources management plan and monitor the implementation,
- To develop water allocation plan
- To develop and submit the water resources related bylaws, acts and norms (for example, the basis of water pricing, water use and pollution fee, methodology of calculation ...)
- To fulfil the responsibilities to carry out the implementation of international conventions, agreements which Mongolia has joined or ratified, and trans boundary water agreement between the two neighbour countries.
- To approve the members of River Basin Councils

Another big issue is a status of the River Basin Councils and their responsibilities and financing. The purpose of River Basin Councils is to decentralize the governmental functions in the field of water resources management, so it is a public-private partnership, which status could be applied in Mongolia.

The territory of Mongolia was divided in 29 river basins. There are two approaches to establish river basin organizations:

1. Existing approach. But, the power of establishment of River basin councils is under the WA. The financial mechanism of the River basin councils must be determined in the Water Law amendments, and,
2. French model: establish river basin organizations as a local department of government agency in charge of water issues, and will be financed from the state budget, i.e., from the water use and pollution fees.

The first approach could be more appropriate for Mongolia depending on water resources, its usage and pollution. The WA shall exercise the power of development of national IWRM plan, in order to success and complete development and implementation of national IWRM plan the competent authority of water issues shall approve the river basin water resource management plan.

As, River basin council is unit to develop and implement the water management plan at river basin level, it could be establish the water use agreement with water user and monitor, require to fulfil the responsibilities according to the established agreement.

5.3. Water use and pollution

In the technical report the difficulties of the classification of water users and water consumers was mentioned. To avoid any misunderstandings it is proposed to use only one term: “water user” and all :water users” are water polluters. Water users can be divided as follows depending in the amount of their daily usage of water resources:

1. Small scale users – household water use / drinking, agriculture, herding for family use
2. Medium scale water users – water sports, tourism, small sized power plants, and small size agriculture and herding. etc.
3. Large scale water user – thermo power plants, large sized agriculture and herding, and industries whose daily usage of water is more than 100 m^3.

The water use right will be issued in last two categories, when the requirements are fulfilled. The requirement set by the competent government organization in charge of environment and nature depending on water use purpose, types. During the period of dry season or drought the water use fee could be increased or the water usage limited.

Everybody who uses water is water polluter, so to apply the “water-polluter-pays” principle. In order to prevent unlimited water use to renew the water use fee and a progressive higher price shall be charged for the amount that exceeds the quota. Related to water use, also will be arrangements on the waste water, in case of exceeding the standard norm also will charged the compensation.

5.4. Financial instrument for water resources management

The financial instrument for water resources management could be enacted by the Water Law amending the related laws. To establish and improve the legal environment for financial instruments as the some legal arrangements exist, for example to reinvest of 35 % of collected water use fees for water resources protection and restoration.

5.5. Legal liabilities

During the meeting with environmental state inspectors, they were complaining about the legal liabilities, mostly the fines charge are too small as an administrative punishment.

And, there were some prohibited regulations, for example Article 11.16, 31.6, 34.1 but the legal liabilities are not identified.

Therefore, there is a need to review the amounts of the penalties also amend the Water law, to set the compensation. In last few years, the Mongolian legal system makes principle changes in fine charging, the amount of fine is not defined, the fine in togrogs equal to 4-40 fold the minimum wage level shall be imposed, depending on violation and citizen or entities.

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Attachment 1. Long list of environment laws

(November, 2010)

No	English Name	Mongolian name/Монгол нэр	Adopted in YYMMDD/ Батлагдсан он-сар-өдөр	Amendments YYMMDD/ Нэмэлт/Өөрчлөлт орсон он-сар-өдөр
Air related laws/ Агаар, түүнтэй холбоотой хуулиуд				
1	Law on Air	Агаарын тухай хууль	1995-03-31	2001-11-30 2002-7-10
Animal related laws/ Ан амьтан, түүнтэй холбоотой хуулиуд				
1	Law on Payments and Authorization Fees for Game Resources Hunting and Trapping	Агнуурын нөөц ашигласны төлбөр, ан амьтан агнах, барих зөвшөөрлийн хураамжийн тухай	1995-05-22	2003-1-2 2006-6-29
2	Law on Ban Controlling and Examination during transportation through border of animals, plants, and raw materials or products of their origin	Амьтан, ургамал, тэдгээрийн гаралтай түүхий эд, бүтээгдэхүүнийг улсын хилээр нэвтрүүлэх үеийн хорио цээрийн хяналт, шалгалтын тухай	2002-11-28	
3	Law on Fauna	Амьтны аймгийн тухай	2000-05-05	
4	Law on Gaming	Ан агнуурын тухай	2000-05-05	2002 -4-25
5	Law on Controlling of Foreign Trade of Rare Animals, Plants and Products of their origin	Ховордсон амьтан, ургамал, тэдгээрийн гаралтай эд зүйлийн гадаад худалдааг зохицуулах тухай	2002-11-07	
Environment law/ Байгал орчин, түүнтэй холбоотой хуулиуд				
1	Law on Investment Percentage of Revenue generated from Natural Resource Usage Payments for Measures to protect environment and rehabilitate natural resources	Байгалийн нөөц ашигласны төлбөрийн орлогоос байгаль орчныг хамгаалах, байгалийн нөөцийг нөхөн сэргээх арга хэмжээнд зарцуулах хөрөнгийн хувь, хэмжээний тухай	2000-01-28	2003-1-2 2004-4-22
2	Law on Environmental Impact Assessments	Байгаль орчинд нөлөөлөх байдлын үнэлгээний тухай	1998-01-22	2001-11-22 2006-5-25
3	Environmental Protection Law	Байгаль орчныг хамгаалах тухай	1995-03-30	1998-1-22 2002-4-25 2002-7-10 2003-01-02 2005-01-06 2005-11-18 2006-06-29 2006-12-22 2008-01-31
Land related laws/ Газар, түүнтэй холбоотой хуулиуд				
1	Law on Mineral Resources	Ашигт малтмалын тухай	2006-07-08	
2	Law on Land	Газрын тухай	2002-06-07	2003-1-2 2003-6-12 2004- 4-22 2005-1-27 2005- 7- 1 2006 -12- 22
3	Law on Land Fees	Газрын төлбөрийн тухай	1997-04-24	2005-7-1 2006-12- 8
4	Law on Subsoil	Газрын хэвлийн тухай	1988-11-29	1995-4-17

No	English Name	Mongolian name/Монгол нэр	Adopted in YYMMDD/ Батлагдсан он-сар-өдөр	Amendments YYMMDD/ Нэмэлт/Өөрчлөлт орсон он-сар-өдөр
5	Law on Land Cadastre and Mapping	Кадастрын зураглал ба газрын кадастрын тухай	1999-12-16	2003-6-12 2006-6- 19 2005-1-27
6	Law on Land Privatization for Citizens of Mongolia	Монгол улсын иргэнд газар өмчлүүлэх тухай	2002-06-27	2005- 06-23 2005-7-7 2008- 5-22
7	Law on Buffer Zone of Special Protected Areas	Тусгай хамгаалалттай газар нутгийн орчны бүсийн тухай	1997-10-23	
8	Law on Special Protected Areas	Тусгай хамгаалалттай газар нутгийн тухай	1994-11-15	2002-6-7 2002- 7-10 2003-1- 2 2004-4-22 2006-12- 22
9	Law on Geodesy and Mapping	Геодези, зураг зүйн тухай	1997-10-31	1999-12-23 2000- 9-1 2003-1-2 2003-6-12 2003-6- 19 2005-1-27
Water related laws/Ус, түүнтэй холбоотой хуулиуд				
1	Law on Spring Water	Рашааны тухай	2003-11-07	
2	Law on Meteorology and Environment Monitoring	Ус цаг уур, орчны хяналт шинжилгээний тухай	1997-11-13	2003-1-2
3	Law on Use Payments of Water and Spring	Ус, рашааны нөөц ашигласны төлбөрийн тухай	1995-05-22	2004-12-02
4	Law on Water Transportation	Усан замын тээврийн тухай	2003-11-28	
5	Law on Water	Усны тухай	2004-04-22	2005-1-27 2009-08-25
6	Law on Urban Water Supply, Sanitation Sewerage Use	Хот, суурины ус хангамж, ариутгах татуургын ашиглалтын тухай	2002-06-13	2004-4-22 2005-1-27
7	Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas	Гол, мөрний урсац бүрэлдэх эх, усны сан бүхий газрын хамгаалалтын бүс, ойн сан бүхий газарт ашигт малтмал хайх, ашиглахыг хориглох тухай хууль	2009-07-16	
Forest related laws/Ой, түүнтэй холбоотой хуулиуд				
1	Law on Protection of Forest and Steppe from Fire	Ой, хээрийг түймрээс хамгаалах тухай	1996-05-28	1999-5-28
2	Law on Payments for Harvest of Forest Timber and Fuel wood	Ойгоос хэрэглээний мод, түлээ бэлтгэж ашигласны төлбөрийн тухай	1995-05-19	2000-1-27
3	Law on Forest	Ойн тухай	2007-05-17	2008 -1-31
Agriculture and plant related laws/Газар тариалан, ургамал, түүнтэй холбоотой хуулиуд				
1	Law on Usage Payments of Natural Plants	Байгалийн ургамал ашигласны төлбөрийн тухай	1995-05-19	
2	Law on Natural Plants	Байгалийн ургамлын тухай	1995-04-11	1997-1-16 2002-6-7
3	Law on Cultivation	Тариалангийн тухай	2004-04-22	2006-6-29
4	Law on Seed, Sorts of Cultivated Plants	Таримал ургамлын үр, сортын тухай	1999-06-17	
5	Law on Plants Protection	Ургамал хамгаалалын тухай	2007-11-15	

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6	Law on Insurance of Seed Planting	Үрийн тариалангийн даатгалын тухай	1999-07-02	2002-7- 4 2002- 12-26
Waste & chemicals related laws/Хог хаягдал, химийн бодис, түүнтэй холбоотой хуулиуд				
1	Law on Household and Industrial Waste	Ахуйн болон үйлдвэрлэлийн хог хаягдлын тухай	2003-11-28	
2	Law on Prohibition of Importing, Exporting and Transiting of Dangerous Wastes	Аюултай хог хаягдлын импорт, хил дамжуулан тээвэрлэлтийг хориглох, экспортлох тухай	2000-11-03	
3	Law on the Protection of Toxic Chemicals	Химийн хорт болон аюултай бодисын тухай	2006-05-25	
4	Law on Radiation Safety	Цацрагийн хамгаалалт, аюулгүй байдлын тухай	2001-06-21	2003-1- 2
Border, state security & emergency related laws/Хил, аюулгүй байдал болон онц байдал, түүнтэй холбоотой хуулиуд				
1	Law on Border of Mongolia	Монгол улсын хилийн тухай	1993-10-21	1994-6-13 1996-1-22 1996-5-20 1999-10-14 2000-12-7 2001-12-27
2	Law on Emergency	Онц байдлын тухай	1995-11-14	
3	Law on National Security	Үндэсний аюулгүй байдлын тухай	2001-12-27	2004-4-23
Other laws/Бусад хуулиуд				
1	Law on Construction	Барилгын тухай	2008-02-05	

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2	Law on Administrative Liability	Захиргааны хариуцлагын тухай	1992-11-27	1993-4-13 1993-10- 21 1993-12-21 1994-1-10 1994-7- 8 1995-4- 17, 28 1995- 6-27 1995-11-16 1996-5-27 1997- 7-4, 7 1997-12-5 1998-1-15, 28 1998-8-20 1999-6- 4 1999-7- 8 1999-10-14 2000- 12-7 2002-6-7 2002-11-22 2002-12-12 2003-5-2 2003-11-20 2004-01-02 2004- 4-30 2006-1-12 2006-1-19 2006-6- 7 2007 -11 – 15 2008 -2 – 1 2008-5-20 Монгол Улсын Үндсэн хуулийн цэцийн 2006 оны 7 дугаар сарын 5-ны өдрийн 3 дугаар тогтоолоор тусгагдсан/
3	Civil Code	Иргэний хууль	2002-01-10	Үндсэн хуулийн цэцийн 2003 оны 01дугаар, 2003 оны 02 дугаар тогтоолоор
4	Constitution Law of Mongolia	Үндсэн хууль	1992-01-13	2000 оны 12 дугаар сарын 14-ний
5	Law on Renewable Energy	Сэргээгдэх эрчим хүчний тухай	2007-01-11	
6	Law on Free Zone	Чөлөөт бүсийн тухай	2002-06-28	2003-1-2
7	Criminal Code	Эрүүгийн хууль	2002-01-03	2004-05-14 2007-12-26 2008-2-1
8	Law on Food	Хүнсний тухай хууль	1999-10-07	2003-5-15
9	Law on Sanitation	Ариун цэврийн тухай хууль	1998-05-07	1998-07-23 2001-01-30
10	Law on Tax	Татварын тухай хууль	2008-05-20	2008-12-19 2009-07-16 2009-10-30

No	English Name	Mongolian name/Монгол нэр	Adopted in YYMMDD/ Батлагдсан он-сар-өдөр	Amendments YYMMDD/ Нэмэлт/Өөрчлөлт орсон он-сар-өдөр
11	Law on Government	Засгийн газрын тухай хууль	1993-05-06	1994-11-15 1996-10-31 1997-06-21 1998-01-15 1999-05-28 1999-06-17 2000-08-03 2000-09-01 2001-01-12 2001-06-21 2001-11-08 2001-12-27 2002-07-10 2003-01-02 2003-06-20 2004-04-15 2004-09-22 2005-01-27 2005-05-26 2006-01-12 2007-06-28 2007-08-02 2007-11-15 2007-11-29 2007-12-13 2008-05-16 2008-09-17 2009-06-11
12		Монгол улсын үндэсний аюулгүй байдлын зөвлөлийн тухай	1992-05-29	1998-05-07 1999-04-22
13	Law on Parliament	Монгол Улсын Их Хурлын тухай	2006-01-26	
14		Аж ахуйн үйл ажиллагааны тусгай зөвшөөрлийн тухай	2001-02-01	
		Засгийн газрын тусгай сангийн тухай	2006-06-29	2007-01-11 2007-02-06 2009-02-13 2009-11-18 2009-11-25

Attachment 2. Implementation of principles and elements of IWRM in Mongolian Legislation

	PRINCIPLES AND ELEMENTS OF INTEGRATED WATER RESOURCES MANAGEMENT	Constitution of Mongolia	Law on Environemntal Protection	Water Law	Law on Spring Water	The Law on Fees for Use of Water Resources and Mineral Water	Law on Urban Water Supply, Sanitation Sewerage Use	Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas	Other legislations
A.	Basic water right and water use right								
A.1	Basic water right			3					
A.2	Dublin principle IV, and beneficial use			1					
A.3	Equitable distribution/supply			1					
A.4	No significant harm			1					
A.5	Water user pay principle			1					
A.6	Managing drinking water			1					
A.7	Managing environmental flow			1					
A.8	Managing agriculture water use			0					
A.9	Managing industrial water use			1					
A.10	Managin mining water use			1					
A.11	Managing different water using sector			1					
A.12	Surface water use			0					
A.13	Groundwater water use			0					
A.14	Water use right			4					
A.15	Basis of limitation of daily water use			0					
A.16	Transboundary water use			1					
B.	WATER ALLOCATION								

B.1	Beneficial use			1					
B.2	Equitable distribution			1					
B.3	Trans-sectoral water allocation			0					
B.4	Water allocation plan			0					
B.5	Drinking water supply during the emergency			0					
B.6	Industrial water use during the emergency			1					
C.	WATER POLLUTION AND QUALITY								
C.1	Prevention from pollution			2					
C.2	Polluter-pays-principle			2					
C.3	Surface water pollution			1					
C.4	Ground water pollution			1					
C.5	Lisencing water pollution			0					
C.6	Drinking water quality			3					
D.	MONITORING AND INFORMATION MANAGEMENT								
D.1	Hydro-meteorological monitoring networks			3					
D.2	Internal water use monitoring			0					
D.3	Water pollution monitoring			0					
D.4	Information collection on water resources			3					
D.5	Accessible of information			1					
D.6	Information dissemination			2					
E.	WATER INSTITUTION COORDINATION								
E.1	Policy development			3					
E.2	Development of legal acts, its enforcement mechanism			3					
E.3	IWRM plan development and participation			1					
E.4	Transboundary water issues			1					
E.5	Water allocation			0					
E.6	Water resource evaluation			1					
E.7	Water use issues			3					
E.8	Water pollution, water quality issues			1					

E.9	Dispute solution			0					
E.10	Raising financial opportunity			0					
F.	STAKEHOLDER PARTICIPATION								
F.1	River basin water resources management planning			4					
F.2	water management decisions making			1					
F.3	Decentralize water management structure			1					
F.4	Mechanisms to discuss/solve water use and transboundary water use issues			0					
F.5	Water pollution control			2					
G.	FINANCING								
G.1	Water sector investment sector			0					
G.2	Allocation of collected fees			0					
G.3	Principles to set water use fees			0					
G.4	Subsidies/credit programs for promoting water conservation technologies			1					

In place and fully implemented -4
In place and partially implemented -3
In place but not yet implemented -2
Not fully in place - 1
Not in place - 0

Part 7.
INSTITUTIONAL ANALYSIS OF THE WATER SECTOR IN MONGOLIA

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1. Introduction

1.1. Background

This institutional analysis report has been written in the framework of the Dutch-Mongolian funded project: "Strengthening of Integrated Water Resources Management in Mongolia". The project, implemented from 2008-2012, comprises the following components:

- Component A: Capacity Building
- Component B: Institutional Strengthening Water Authority
- Component C: National Water Resources Plan (NWRP)
- Component D: Pilot River Basin Plan
- Component E: Project Management

The component A: Capacity building aims to improve capacity in the field of IWRM in Mongolia by training the staff of the project partners and of other selected parties as well as by providing (and securing future) academic studies. Though capacity building can be regarded part of institutional development other project specialists have covered this field and reference is made to the relevant reports on this subject. This report does not further elaborate on this aspect.

The aim of Component B is to strengthen the role of the Water Authority in the management and planning of the water resources to carry out the task of central water organization in the country. The activities under Component B are listed as follows:

- Activity B-1: Capacity development for water management planning
- Activity B-2: Capacity development in water assessment
- Activity B-3: Establishment of the national water resources monitoring network for quantity and quality
- Activity B-4: Water tariff structure
- Activity B-5: Effluent standards for waste water from chemical industry
- Activity B-6: Procedures for data base management
- Activity B-7: Data accessibility
- Activity B-8: Support professional organisations
- Activity B-9: Support institutional development
- Activity B-10: Raise public awareness about water issues and

This report specifically focuses on activity B-9: Support institutional development. Recommendations and proposed measures from the analyses in this report will be included in the national Water resources Plan and Pilot River Basin Plans of Components C and D respectively.

The recommendations of the Mid-Term Evaluation, carried out in April/May 2011, with regard to limiting the scope of the institutional strengthening task of the project were subsequently adopted by the project's Steering Committee on 13th May 2011 (see Box 1).

Box 1. Recommendations by the Mid-term Review Mission

Recommendation 4: On the Project engaging in institutional reform

1. The Project is to complete its analysis of the current institutional set-up of the water sector, including the identification of trends and gaps and conclusions thereupon; but is not expected to develop detailed proposals for restructuring of the Water Sector. The Project shall support the co-operation between National Water Committee and Water Authority.
2. The Project Document has placed an ambiguous expectation on the Project by asking for 'institutional strengthening' of the Water Authority. The term 'institutional strengthening' can be – and is – interpreted differently by different people, and has led to the Project spending some of its resources on re-defining the institutional structure of water management in Mongolia. The Mission proposes to rephrase 'institutional strengthening of the WA' as 'strengthening the capability of the WA', and to focus on developing the knowledge base in the Water Authority, in addition to investments in building and equipment that have already been made.

Source: Final Mid-Term Evaluation Report, June 2011

1.2. General

As populations continue to grow and demands on water resources increase, policy makers in general and water managers in particular are faced with a range of critical questions. How to develop reliable sources with sufficient water to continue to meet all the diverse needs? How to ensure adequate water quality, and protect sources from pollution? And how to minimise the adverse impacts of water abstraction and water pollution?

Finding answers to these questions, and putting in place processes that lead to sustainable solutions, is of increasing importance as we continue to see more conflicts over access to water, more systems failing due to management or resource problems, and rising investment and recurrent costs.

IWRM has emerged during the last decade as a response to the 'water crisis': the widespread and well-articulated concern that the planet's freshwater resources are coming under increasingly unsustainable pressure from rising populations, growing demands for water and increasing pollution. The most fundamental consideration is that IWRM means a move away from traditional sub-sector based approaches to a more holistic or integrated approach to water management based upon a set of agreed key principles. Taken together, the principles offer a framework for analysing, and subsequently managing multiple uses of water in situations of increasing competition and conflict where resources are scarce. These actual or potential conflicts often threaten the security of water supplies and it is believed that IWRM has a great deal to offer in this context. IWRM also provides a framework for water management to better consider and manage the impacts on other water users in particular those who are far away from the decision-making processes.

Additional to water resources assessments, and social-, financial-, and economic analysis of the water sector; water governance issues as legal and institutional assessments of the water are essential for the development of IWRM. The introduction of IWRM requires an institutional setting conducive for IWRM's key principles:

- the principle of subsidiarity or decentralized versus centralized governance
- the principle of cross-sectoral integration or 'coordinated management'
- the principle of stakeholder participation in decision making for water management

The objective of this report is to assess existing institutional arrangements within the context of these IWRM principles and to identify the constraints and bottlenecks for the introduction of IWRM in Mongolia. Based on a thorough analysis recommendations will be forwarded for the further improvement of the institutional structure for water management in Mongolia.

Approach

This institutional analysis is made with the aim of designing a development path for the introduction of integrated water resources management (IWRM) in Mongolia. IWRM recognizes a strong interrelation between the management of water, land and environmental management. An intervention in any of these fields will usually affect the other fields as well. For that reason also land and environmental management - for as far as it touches upon water - are included in this analysis.

From the perspective of IWRM all the necessary functions that need to be carried out in water management; land management and environmental management have been identified and surveys using standardized questionnaires have been carried out to establish who is doing what (i.e. the actors, see Box 2) and how these functions are actually carried out. This yields a complete list of the actors in water management and the functions they perform.

Box 2. Definitions for 'Stakeholders' and 'Actors'

Stakeholders
- Those who (should) invest/implement
- Those who (will) manage the system
- Those who (would) benefit/suffer from the system
- Those who have the power to obstruct or destroy the system

Actors
- Those who take decisions regarding the (management of the) system, including policy decisions

An institutional analysis tool (MIMAT) is used to order and arrange all the information gathered on actors and functions to assess to what extent IWRM criteria for water management are satisfied, what the bottlenecks are, whether there are overlaps or gaps, where improvements can be made, and what changes need to be made.

As IWRM is a very broad concept, there are likely to be numerous actions needed to introduce IWRM. To come up with an efficient way of introducing IWRM an analysis is made to determine what the most crucial steps are to be taken first. On the basis of that a number of required measures are formulated that are crucial to initiate the introduction of IWRM in Mongolia.

This institutional analysis has been prepared using:

- International and national publications on IWRM in general and case studies that compare to the situation in Mongolia, like the UFZ-Diskussionspapiere, entitled: "Institutionalising IWRM in Developing and Transition Countries – The Case of Mongolia (July 2010)".
- Existing data and reports on the institutional setting in Mongolia, like the UNDP report entitled "Needs Assessment on Institutional Capacity for Water Governance in Mongolia, UNDP Mongolia, 2009". A reference list of the data sources is provided.
- Interviews
  Several sets of interviews have been held in the course of preparing this analysis with stakeholders and key actors in the water sector in Mongolia:
  - In May 2010, orientation interviews have been held solely for the IWRM

project with relevant persons from major actors in the water sector such as members of the NWC, staff members of the WA and MNET.
- In October 2010 a second round of interviews was held for the IWRM project as well as for the WB-financed project Groundwater Management in Southern Mongolia. These interviews focussed on the need to set up basin councils in the southern basins of Mongolia where groundwater is the principle water resource.
- Interviews were held with about 70 representatives of the key actors in water management to determine the particulars of their organisations. The outcomes of these interviews are compiled in the Technical Report '*Actor Analysis*'. The data obtained from these interviews form the input for the MIMAT analysis.

- MIMAT- based stakeholder analysis
  A computer aided institutional analysis tool (the MIMAT-software developed by Royal Haskoning) to systematically process institutional data and analyse key institutional parameters in the context of IWRM. A general description of the MIMAT software is provided in Annex 2.

Finally conclusions and recommendations have been formulated based on a thorough synthesis and analysis of the information gathered.

1.3. This report

This report describes in Chapter 2 the legal basis for water management followed by a detailed description of the institutional landscape of the water sector in Chapter 3. Chapter 4 presents the institutional analysis that provides the basis fpr the conclusions and recommendations presented in Chapter 5.

This report was initially prepared in 2011 and therefor the analyses presented here were made in the context of the Water Law (2004) that was in force at the time. On 17 May 2012 a revised version of the Water Law was adopted by the State Khural (in this report referred to as the Water Law (2012)). Where possible this report has been updated in the context of the Water Law (2012). The amendments on the Water Law (2012) published in the Government Gazette No. 33 (17 August 2012), which among others formalizes the disbanding of the Water Authority, have been acknowledged, but have not been included in the analyses this report as the new organisational structure has not yet completely taken effect.

2. Legal basis of water management

2.1. Existing laws and regulations

In Mongolia, currently 53 laws regulate the protection of the environment; the proper use of natural resources and the restoration of available resources (see Annex 7). These laws concern the management of air, water, land, forest, animals, mineral resources and others in Mongolia.

There are nine laws that specifically regulate the effective use, protection, and restoration of water resources; water use fees and water supply (see Table 1). The Water Law of 22 April 2004, now replaced by the Water Law of 17 May 2012, serves as an umbrella law for water resources management. The Water Law introduced new concepts, for example:

- The law defines the mandates of the State organizations that are in charge of development and adoption of integrated water resources management plans;
- The law introduces the concept of River Basin Councils and River Basin Authorities, opening the way for decentralization of water management and facilitating involvement of citizens in water management;
- The law provides the legal basis for the introduction of IWRM and establishes an institutional framework that includes a better positioning of some vital IWRM organizations.
- The law opens the way for the private sector to engage in water management activities e.g. through state corporations and PPP arrangements

Table 1. Laws directly related to water resources (as of September 2012)

#	Name of law	Promulgated	Last amended
1	Water Law (2012)	2012-05-17	2012-08-17
2	Water Law (2004) (replaced by Water Law (2012)	2004-04-22	2009-08-25
3	Law on Springs	2003-11-07	
4	Law on Fees for the Use of Water and Mineral Water	1995-05-22	2004-12-02
5	Law on Meteorology and Environment Monitoring	1997-11-13	2003-01-02
6	Law on Urban Water Supply, Sanitation Sewerage Use	2002-06-13	2005-01-27
7	Law on Water Transportation	2003-11-28	
8	Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas	2009-07-16	
9	Law on re-investment of natural resource use fees for the protection of the environment and the restoration of natural resources.	2000	

On July 16th, 2009, the Government of Mongolia adopted the Law on 'Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas' to protect water basins and forest areas. This was mostly done to protect water resources and source areas from the negative impacts of mining activities.

After promulgation of the Water Law (2004), the following important by-laws were developed:

- River Basin Council Rule (Ministerial order of Environment No 187, year 2006),
- Regulation on Registration of Water Resources (Ministerial order of Environment No 269, year 2006),

- Regulation on Water Database, its recording (Ministerial Order of Environment No 180, year 2006)
- Form of Water Use License (Ministerial Order of Environment No 298, year 2006)

The existing legislation on water in Mongolia left room for improvement on the following points:

- definitions of the terminologies (sometimes overlapping with other legislation)
- regulation on water use
- further detail powers and liabilities of water management organizations
- water allocation and dispute resolution mechanisms
- safeguarding mechanisms against pollution, droughts, and floods
- wetland management
- pricing of water
- financing of water management
- enforcement

An amendment on the Water Law was prepared by a working group under the NWC during 2010 and 2011 addressing most of these issues. The WA has been actively participating in this working group. The amendment, thus prepared, has resulted in the promulgation of the Water Law (2012) on 17 May 2012. In the following chapters of this report the changes from the Water Law (2004) in the Water Law (2012) are laid out with regard to the specific subjects.

Law enforcement is the main domain of the State Inspection Agency and its decentralized offices at aimag and soum level. Law enforcement generally is weak due to lack of technical expertise and the small number of staff compared to the area that needs to be covered, while the penalties seem to be too small to deter offenders.

There are also some 56 laws related to environmental management. The umbrella law is the Environment Protection Law, adopted in 1995. In Article 3 of the Environment Protection Law, water is mentioned in the list of resources to be protected. Specific laws are formulated to protect the natural resources and to regulate the proper use of these resources, ensuring the ecological balance. Specifically the discharge of wastewater is regulated in the Environmental legislation. Those environmental laws with a bearing on water are included in the list of laws in Annex 7.

2.2. Legal basis for institutional setting

Besides the Water Law (2012) having replaced the Water Law (2004), several other laws complement the legal basis for the existing institutional setting in the water sector such as the Constitution of Mongolia, the Parliament Law, the Government Law, the Law on Environmental Protection, the Law on Fees for the Use of Water and Mineral Water, the Law on Urban Water Supply, Sanitation and Sewerage Use, etc.

The Water Authority was established in 2005 and its legal mandate is based on the Water Law (2004). Article 12 of this Law states that the Government Agency in charge of water issues (the Water Authority) shall operate within the then Ministry in charge of Nature and Environment (now MNET). The law also requires the establishment of River Basin Councils (RBC) in identified water basins.

The legal mandate for the Water Authority was based on the Water Law (2004) and was further enhanced by the Water Law (2012), which states that the Government Agency in charge of water issues (the Water Authority) shall operate within the Ministry in charge of Nature and Environment. The Water Law (2004) also required the establishment of River Basin Councils (RBC) in identified water basins. The Law further specifies the responsibilities of the Water Authority and the RBCs including the main IWRM tasks such as water resources assessment, planning of water resources, monitoring, protection, research, etc. The tasks and responsibilities however, focus on implementation and policy making responsibilities are not well specified.

The Water Law states that River Basin Councils will develop the River Basin Water Management Plans, and submit the draft plan to the respective level Citizen's Representative Khurals for approval and monitoring of its implementation.

2.3. Legal basis for water pricing

Financing of investments, operation and maintenance in the water sector a thorny issue in almost every country that requires striking a political balance between treating water as an economical good on the one hand and as a social right on the other hand.

The Water Law does provide regulations for water utilizing and exploration. Depending on the purpose for water utilization the Water Law distinguishes "water consumers" and "water users":

- "Water consumers" are the citizens, economic entities and organizations who utilize water or the water environment for non-profit purposes such as drinking, household, herding and agriculture; Water consumers are exempted from paying water use fees, although, depending on how they receive their water, they are charged a service fee. Water users include for the energy sector, crop production, livestock and herders water supply (outside the town centres), and domestic water consumption
- "Water users" are those who use water or the water environment for profit in the industry and services sectors. Water users are charged a water use fee.

While this distinction on the one hand protects the right to water, on the other hand it is at odds with the principle that considers water as an economic good.

Water fees in Mongolia are regulated by two laws: the "Law on Water and Mineral Springs Use Fees" and the "Law on the Amount of Expenditure for the Measures to Protect the Environment and to Restore Natural Resources". These laws provide the legal basis to charge a service fee for domestic water supply and a water use fee for industrial water supply. In 2006, water use fees for industries included: heavy manufacturing (MNT 20 - 30/m^3)[1]; manufacturing (MNT 10 – 30/m^3); mining (MNT 80 – 120/m^3); food & beverage (MNT 10 – 30/m^3); and "other" industries (MNT 10 – 30/m^3).

The Law on Water and Mineral Springs Use Fees that specifies the fees to be paid for the use of water was recently amended to include the following in order to implement the article on water user fee of the Water law (2004):

- The water use fee for mining shall be calculated according to the cubic meters of water used (Article 6.1.3)
- Minimum and maximum fee limits of water use is determined by water use purpose, classifying by surface and groundwater (Article 7.1)

1 For each range, the lower boundary is for surface water use; the higher boundary is for groundwater use

The Law on Re-investment specifies that 35% of the water use fees collected is to be spent on water management and protection and in addition a similar amount is to be allocated for water management and protection from the State Budget. In practice however, this doesn't happen and the water management activities are generally paid from State budget.

Licensing for water use and payment for the water use is arranged by the Water Law. Licenses are commonly granted – for larger quantities after approval of an Environmental Impact Assessment report. Agencies, involved in the licensing process for groundwater, are listed in Table 2.

Table 2. Licensing agencies for water use

Licensing Agency	Mandated to licence for yields per exploitation of:	Remarks
Soum Governor	< 50 m^3/day	
Aimag Governor	50 – 100 m^3/day	
Water Authority	> 100 m^3/day	based on EIA report

Licenses are granted on the basis of information provided by the persons or company, requesting the license. Proposed groundwater exploitation is generally not reviewed independently in a local or regional context due to lack of data and expertise with the licensing agencies on the detailed local hydro-geological system. Licenses are usually granted without detailed consideration of impact on available resources or other users.

Payment of the water use fees are made to the local tax offices. Soum Tax Inspectors report to the Aimag Tax Divisions, who in turn report to the Mongolian Tax Authority. The national tax office should report annually on the taxes thus collected.

Already in the Water Law (2004) in Article 30 and again with more detail in Articles 20 and 21 of the Water Law (2012) it is stated that citizens, economic entities and organizations that pollute water shall be subjected to a water pollution compensation fee and that the amount of that compensation would be set by law. Till now, this part of the Water Law has not yet been implemented, as the law to set the amount of the fees has not yet been developed.

3. Institutional landscape of the water sector

3.1. Existing Institutional setting

3.1.1. General

In 1992, the first Mongolian democratic constitution was ratified after almost a century of soviet modelled single party communist rule with a strongly hierarchical and centralised system of government. Following its new constitution Mongolia becomes a parliamentary republic. The President and the members of the State Great Khural (parliament) are elected for tenures of four years. In 2010 the government consisted of 11 ministries; after the installation of the new government in 2012 that became 16.

Since 1990 the country has been making a transition towards a market economy. Nevertheless most of the administrative layers of government dating back to the communist era have remained in place, although the strongly hierarchical system of governing has eased somewhat.

Administratively Mongolia is divided into 21 aimags (provinces) and one municipality (the capital city) (see Figure 1). Aimags are subdivided into 329 soums (districts in the urban environment) (see Figure 2) and soums into 1568 bags and khoroos.

Figure 1. Administrative map (Aimags)

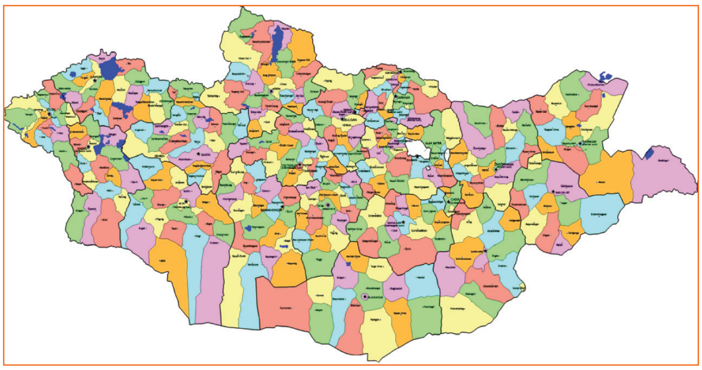


Figure 2. Administrative map (Soums)

The Constitution of Mongolia provides for a certain degree of self-determination for the administrative units. The central government provides direction to the administrative unit through its allocations from the central budget. Each administrative unit establishes a local parliament composed of elected local representatives, while the central government is represented in each unit by a governor. The governor is appointed by the Prime Minister and is thus implementer of decisions made at both of local parliament and the central government. Water management also follows this pattern which implies that operational water management has been decentralized to the provincial level under centralized policy and financial coordination.

This is only part of the institutional complexity of the water sector in Mongolia. Several ministries (9) are involved in the management of the water sector in one way or the other. Their roles have evolved over a long period of time. Some 13 main agencies and more minor ones are involved in various aspects of water sector planning and management, often with overlaps and sometimes leaving gaps. Figure 3 gives a simplified impression of the complex arrangement of relations at the various administrative levels as it existed in 2010, the time this analysis was made. The diagram only depicts the main players in the water sector. A more detailed figure of the organization of the water sector is presented in Annex 1.

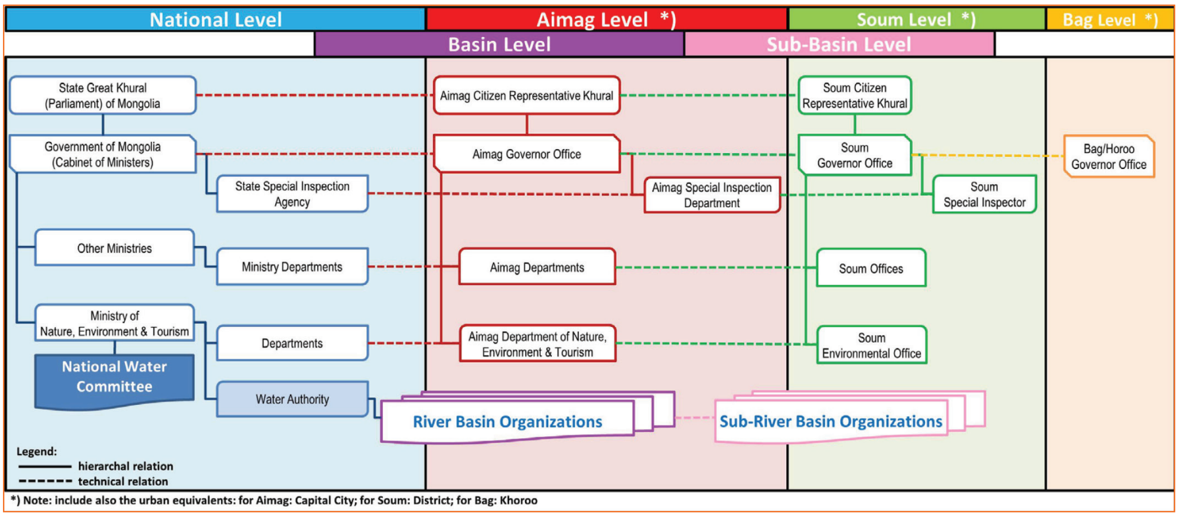


Figure 3. Simplified institutional structure of the Water Sector in Mongolia (2010)

The Water Law of 22 April 2004, now replaced by the Water Law of 17 May 2012, serves as an umbrella law for water resources management. The Water Law introduced new concepts, for example:

- The law defines the mandates of the State organizations that are in charge of development and adoption of integrated water resources management plans;
- The law introduces the concept of River Basin Councils opening the way for decentralization of water management and facilitating involvement of citizens in water management.
- The law provides the legal basis for the introduction of IWRM.

Several other laws complement the legal basis for the existing institutional setting in the water sector such as the Constitution of Mongolia, the Parliament Law, the Government Law, the Law on Environmental Protection, the Law on Fees for the Use of Water and Mineral Water, the Law on Urban Water Supply, Sanitation and Sewerage Use, etc.

In the next sub-chapters the main institutional players at national level and local level are discussed.

3.1.2. Public administration at national level

The Water Law (2004) empowered the State Great Khural to define the state policy on water and to set fees for use of water resources. Within the framework of established fees and policy, the Government ensures implementation of the state policy on water and allocates budgets for protection of water resources, restoration and irrigation from the annual state budget. It also adopts national water management plans.

Recently the Mongolian Parliament promulgated the revised law on water, the Water Law (2012) effectuating a number of changes in mandates and responsibilities for the State Great Khural and the Government of Mongolia with regard to water. In Table 3 an overview is presented detailing the changes in the mandates and responsibilities of the Parliament and the Government of Mongolia between the Water Law (2004) and the new Water Law (2012).

Table 3. Overview of the mandates and responsibilities of the Parliament and the Government of Mongolia; comparing the Water Law (2004) and the Water Law (2012)

Water Law (2004)	Water Law (2012)	Remarks
Mandates and Responsibilities of the Parliament of Mongolia		
to define the state policy on water		The new Water law introduces Public-Private Partnerships (PPP) and regulates waste water management. Some terms like "major" in the law have not been adequately defined allowing for ambiguity in the interpretation of the law
to set fees for use of water resources	to set fees for use of water resources and for water pollution	
to decide on regulation of major rivers' discharge modification and transfer	to decide on regulation of major rivers' discharge modification and transfer	
to ratify and cancel international treaties with neighbouring countries on cross-border rivers and lakes		
Mandates and Responsibilities of the Government of Mongolia		
to organize and ensure implementation of the state policy on water	to adopt National IWRM plans;	It is assumed that the state water policy is reflected in the National IWRM plan. Therefore, the state water policy is defined by the Government of Mongolia. The National IWRM plan covers not only drinking water supply issue; it covers all water use related aspects and associated management activities.
to adopt state water management plans		
to allocate budgets for protection of water resources, restoration and irrigation from annual state budget		
to make decisions on utilization of river waters for production of electricity and energy		
to adopt programs for supply of drinking water for the population that meets health and sanitary requirements		
	to reach agreements with neighbouring countries on trans-boundary water issues	Under the Water Law (2004) this was the mandate /responsibility of the Parliament of Mongolia. However, de facto the Government of Mongolia has always taken the responsibility for these issues. Therefor assigning this mandate to the Government merely formalizes a de facto situation
to adopt water ecology-economic evaluation	to adopt water ecology-economic evaluation	
	to establish the National Water Committee for ensuring cross sector and overall coordination at the national level and for conducting regular monitoring on the implementation of the National Water Program	The new – more permanent - status and its elevation in the government hierarchy have considerably enhanced the capacity of the National Water Committee to become a more effective coordinating body.
	to decide on regulation of rivers' discharge modification and transfer for rivers not considered to be a major river	The term "major" has not been defined adequately.

The Government law (1993) places water issues under the responsibility of the Minister of the then Ministry of Nature, and Environment (now Ministry of Nature, Environment and Tourism, MNET). This is further specified by the Water Law to include issues related to water resources protection; conservation and restoration. State policy development and implementation with regard to water use is the responsibility of several ministries and government agencies.

Crucial in IWRM are the coordinating bodies and their performance. The institutions which have a formal responsibility for coordination in water management are:

- the Government of Mongolia (i.e. the Cabinet)
- the Ministry of Nature, Environment and Tourism (now the Ministry of Environment and Green Development)
- the Water Authority (now absorbed in the MEGD's new Department for Coordination of Policy Implementation)
- the National Water Committee
- the Aimag and Soum Governors
- River Basin Committees

Ministry of Nature, Environment and Tourism

Concerning water, the Water Law and the Law on Environmental Protection vest the MNET with the responsibilities regarding water resources use, water resources protection, and water resources restoration. A detailed overview of the mandates and responsibilities of the MNET is presented in Table 4 indicating the changes in the Water Law (2012) as compared to the Water Law (2004)

Table 4. Overview of the mandates and responsibilities of the Ministry of Nature, Environment and Tourism; comparing the Water Law (2004) and the Water Law (2012)

Water Law (2004)	Water Law (2012)	Remarks
to approve water exploration and research reports and formalize potential reserve for utilization	The authority in charge of environmental issues [MNET] shall establish the 'Water Resources Council' that will formalize the total and the exploitable water resources	the 'Water Resources Council' takes over this role from the Water Authority's 'Board of Professionals'
to submit draft IWRM plans to the Government; to implement water resource management policies and regulations to ensure a natural and ecological balance	to develop and submit the National IWRM plan; and to provide necessary cross sector, regional and policy coordination at all levels	This coordination task of the MNET is overlapping with the mandate of the National Water Committee of the Government.
to develop and implement an integrated scientific and technological policy on water resource research		
to approve rules, procedures, methods, and guidelines on water use, on protection, on habitat restoration, and on possession and exploitation of water points and water facilities and implement these in conformity with legislation through the respective government organizations	to approve rules, procedures, methods, and guidelines related to water use assessment, inventory, water resources ecology and economic valuation, water resources monitoring, restoration of water resources area, utilization and ownership of water facilities and infrastructure and implement these through the respective government organizations	
to operate a water monitoring network for determining water resources, its quality, changes in reserve volume, water storage and distribution		
to monitor the maintenance of the state water databank and cadastre	to monitor the maintenance of the state water databank and cadastre	

Water Law (2004)	Water Law (2012)	Remarks
to distribute water and to restrict water use for industrial purposes or temporarily prohibit the use of particular water resources for restoration of water resources and habitats in zones where its natural restoration cycle had been degraded	to approve and implement methods, and guidelines for estimating and valuating damages to the water resources	Despite the fact that on occasion it was urgently needed the MNET has never used their mandate to restrict water use for industrial purposes or temporarily prohibit the use of particular water resources. Under the Water Law (2012) this mandate has been transferred to the Water Authority.
to organize the implementation of programs to supply the population with drinking water that meets health and sanitary standards in collaboration with relevant government organizations	to approve regulations for proper use and protection of natural springs	Regulations for natural springs are a new element in the Water Law (2012).
to grant or suspend a right for water exploration and research to professional organizations	to grant or suspend a right for water exploration and research to professional organizations	
to conclude with neighbouring countries agreements on establishing cross-border water stations and guards and to take preventive measures for floods and other disasters	to implement trans-boundary water agreements	Establishing and implementing trans-boundary water agreements was de facto done by the Water Authority. The role of the MNET was limited to transferring documents between involved organizations. The Water Law (2012) enhances the role and responsibilities of the MNET in trans-boundary water relation.
to plan, allocate budgets, evaluate and finance research and exploration for water resources and estimation of the potential reserves for utilization; to select and appoint researchers and explorers for water resources and estimation of their potential reserves for utilization	To organize research and exploration for water resources and establish their potential reserves for utilization	
	to designate and create river basins considering catchment and administrative boundaries, environmental characteristics, hydrological cycles, resource allocations, etc.; to establish River Basin Authorities; to approve Bylaws and organizational structure of River Basin Authorities; to appoint and dismiss Directors of River Basin Authorities; to approve standard guidelines for the development of river basin management plans	The full mandate regarding implementation of river basin management based on the National IWRM plan is assigned to the MNET.
	to decide on river discharge modifications and transfers	The legal environment makes it possible to make scientifically justified decisions on river discharge modifications and transfers.

Water resources issues (e.g., pollution; monitoring and impact assessment aspects) are managed by MNET's Department of Environment and Natural Resources (Government resolution 65, 2008). This department is in charge of water policy development and ensuring policy implementation.

The MNET has three implementing agencies: the Government Implementation Agency for Water (commonly referred to as the Water Authority), the Government

Implementation Agency for Forests or in short the Forestry Authority and the National Meteorology and Environmental Monitoring Agency (still commonly referred to by its old acronym: NAMHEM). These implementing agencies are answerable to the Minister. In 2010, at the time of this analysis the structure of the Ministry of Nature, Environment and Tourism is shown in Figure 4. The restructuring of the Government in August 2012 also affected the organisational structure of the MNET, which was renamed the Ministry of Environment and Green Development. The new ministry structure is given in Figure 5.

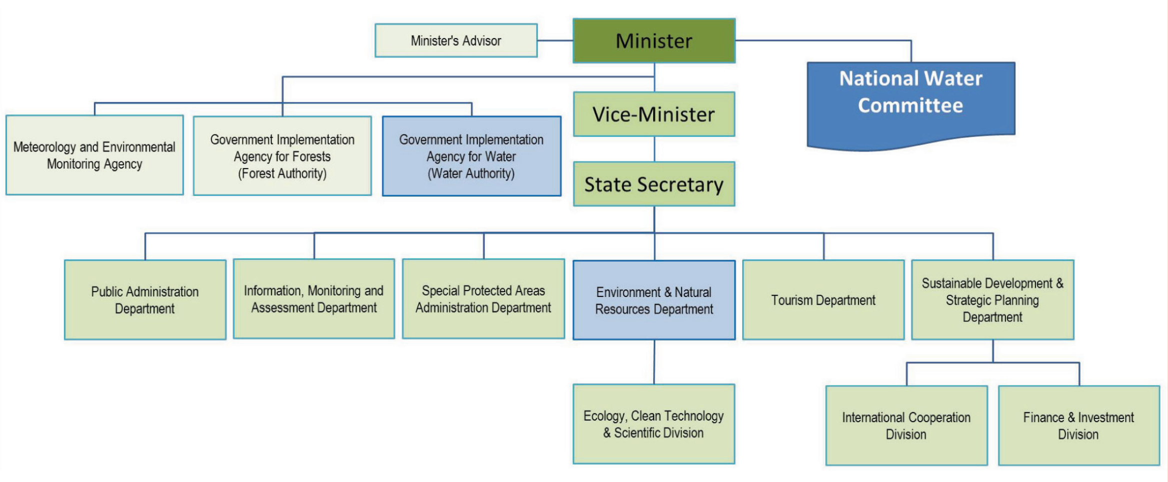


Figure 4. Organizational structure of the Ministry of Nature, Environment and Tourism (2010)

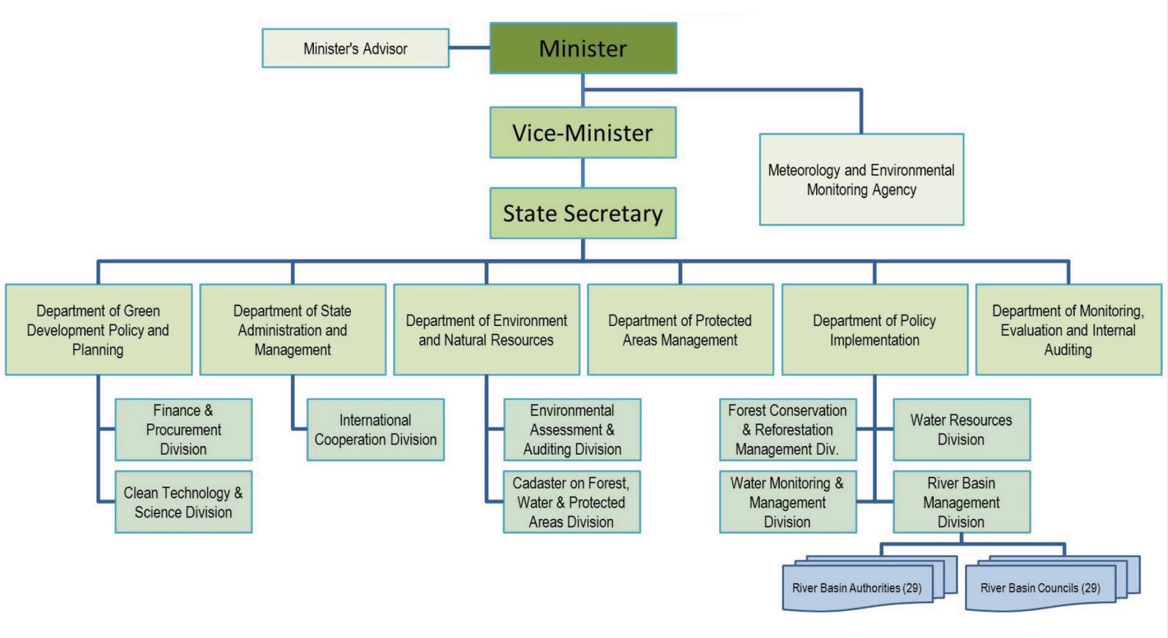


Figure 5. Organizational structure of the Ministry of Environment and Green Development (2012)

The National Water Committee (NWC) is also depicted in the organogram of the ministry (2010), although formally it was not part of the structure of the ministry. However with the Minster of MNET as chairman, the NWC Secretary appointed by the Minister of MNET and NWCs offices located in the ministry building, there was ample reason to consider NWC as part of the MNET.

National Water Committee

In 1998 the National Security Council of Mongolia discussed the issue of water resource utilization and designated it a matter of national security to be managed properly. Subsequently the decision was taken to develop a National Water Program (NWP) and establish a National Water Committee. The decision was followed up by a Government Regulation in 1999 that approved the NWP and established the National Water Committee to ensure inter-sector coordination of the national water policy and the NWP. The structure of the NWC was approved by the Government Resolution # 214 (26 September 2001). According to the resolution, the Deputy Director of the Cabinet office was to head the National Water Committee. However, in 2003 the structure of the National Water Committee was modified by Government Resolution # 4 designating the Minister of Nature, Environment and Tourism as the head of the National Water Committee.

The present structure of the National Water Committee is presented in Figure 7. Under the new Government structure the NWC has been placed under the chairmanship of the Prime Minister (see Figure 6).

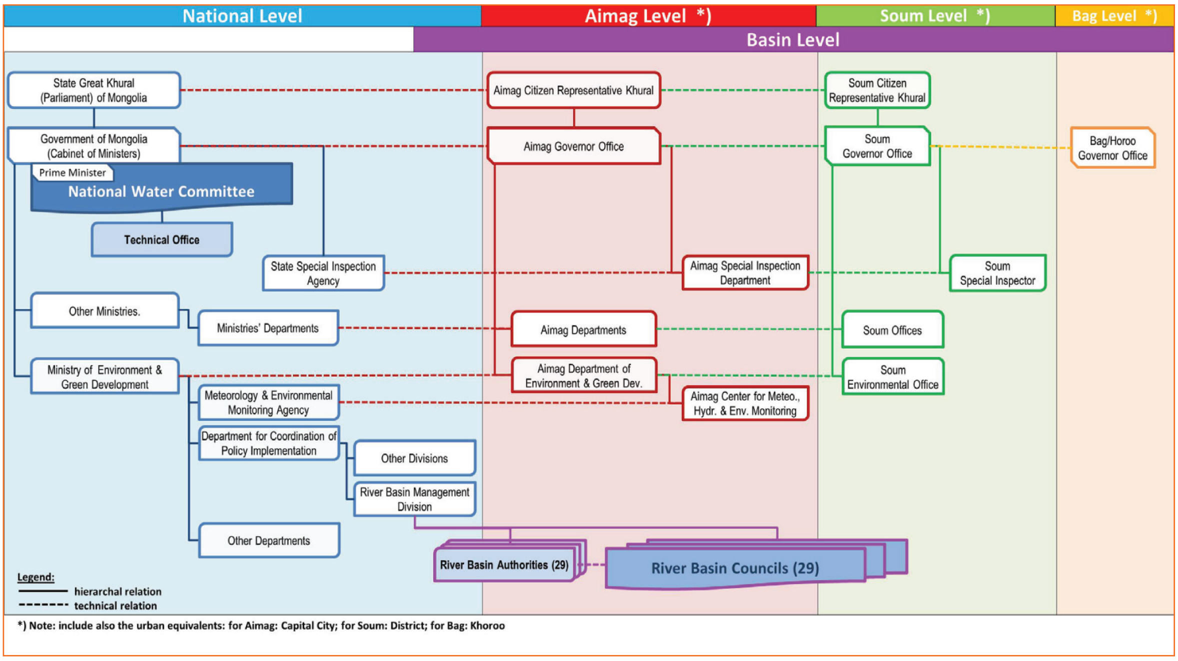


Figure 6. Simplified institutional structure of the Water Sector in Mongolia (2012)

The Water Law (2004) does not mention the National Water Committee and the National Water Committee derives its position and mandates from the above mentioned Government Regulations. A National Water Program is a finite multi-year program. The NWC's tenure expires with the completion of each National Water Programme and the NWC may be abolished or (re-)established by Minister's Order when a new NWP is taking force. In the Water Law (2012) this is changed. The National Water Committee has been made a permanent body to provide overall coordination under the Government. The National Water Committee of the Government office is to monitor the implementation of the National IWRM plan.

The National Water Committee has two levels of coordination (see Figure 7):

- a Committee comprising the State Secretaries of relevant Ministries and some NGO representatives (Minister's Order, 2009), and

- an Operational Group that suggested to advice on crucial issues to the Committee of State Secretaries. This group was established by Ministerial Order # 245 (2007) for strengthening and intensifying the functioning of the NWC and operates on an ad-hoc basis.

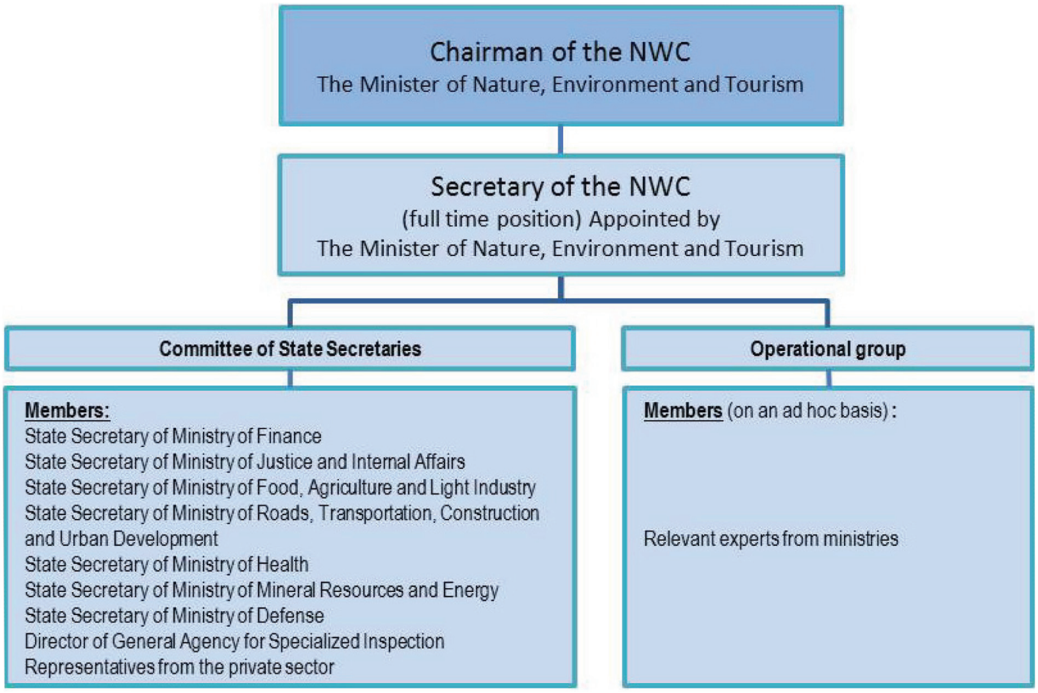


Figure 7. Structure of the National Water Committee (2010)

According to Government Resolution # 214 (2001), the mandate and responsibilities of the National Water Committee are:

- to monitor the implementation of the National Water Program (NWP)
- to enhance integrated leadership to the activities that are conducted under the program
- to collaborate with both national and international organizations within the scope of program work
- to enhance inter-sector operational relations
- to support, monitor, activate, analyse and evaluate the implementation of the NWP
- to develop recommendations to amend the program and get it solved according to the Regulations, get the report discussed by the Government

These functions are being executed by Secretary and officer of the NWC on daily bases.

Water Authority

The Water Authority was established in 2005 and its legal mandate is vested in the Water Law (2004). In Article 12 of this Law it is arranged that the Government Agency in charge of water issues (i.e. the Water Authority) shall operate within the then Ministry in charge of Nature and Environment (now MNET). By the Parliament Resolution # 11 (27 June 2005) following the Government Resolution # 46 (9 March 2005) the Agency for Water Affairs was established with status of a government implementing agency. In 2008 the name was changed to "the Water Authority" by Parliament Resolution # 43 and Government Resolution # 64 respectively.

The vision of the Water Authority is "To provide professional and managerial service in implementation of state policy on proper utilization, protection and restoration of water resources in Mongolia".

The Water Authority's tasks and responsibilities have been detailed in the Water Law (2004) and amended in Water Law (2012). In Table 5 the mandates and responsibilities of the Water Authority are presented indicating also the changes that were introduced in the Water Law (2012).

Table 5. Overview of the mandates and responsibilities of the Water Authority; comparing the Water Law (2004) and the Water Law (2012)

Water Law (2004)	Water Law (2012)	Remarks
to develop management plans for integrated water resources utilization, protection and habitat restoration	Develop and draft the National IWRM plan	
to develop plans for water research and exploration, mapping, scientific studies and research	to execute water research and exploration, mapping, scientific studies and research and to monitor the process of conducting research and exploration	The mandate of the Water Authority has been enhanced by the new law as it is now given the responsibility to control the process of water research and exploration.
to adopt measures and ensure implementation to economize water resources, its reuse, set monitoring quantity for each user and for river basins	to estimate and approve the exploitable water resources for each user and for river basins;	
to develop ecology- economic evaluation for water	to develop ecology-economic evaluation for water and to estimate and valuate any damages to the water resources	
to develop and submit for adoption technical status and standards for treatment of industrial waste waters and services that use chemicals based on advanced technological and scientific procedures; to organize ecological assessment of water in water basins	to develop water quality and waste water standards	Waste water management and Public Private Partnerships were introduced by the new law.
to provide professional management support to River Basin Councils, professional organizations in the water sector, aimag and capital city authorities in charge of nature and environment management	Provide River Basin Authorities with professional guidance and coordination	The River Basin Authority is the professional organization at the basin level that will be responsible for water management, while the River Basin Council is the organization responsible for bringing the public and local communities into the water management.
to make professional evaluation on temporary or partial alterations of river channel, regulation of river discharge and utilization of water basin land	to make professional recommendation on decisions regarding river discharge modifications and transfers, and draft proposals for the utilization of reservoirs	This legal embedding opens the way to make scientifically based decisions on river discharge modifications and transfers.

Water Law (2004)	Water Law (2012)	Remarks
to monitor and research changes in water resources, to maintain water database and cadaster, to provide citizens, economic entities and organizations with information on water conditions	to operate and monitor the state water resources database and to provide the public with information related to the condition of the water resources	Although the responsibility to conduct hydrological monitoring was given to the Water Authority by the Water Law (2004) the National Meteorology and Environmental Monitoring Agency is still carrying out surface water monitoring and operates the related monitoring networks and facilities.
to develop and ensure compliance of the technical conditions for recycling industrial waste water		
to monitor research and exploration activities a decision for hydro-geological and hydrological exploration research of water resources for economic zone and water basin area and of water resources for household and industrial use, economic entities and organizations and validate its implementation reports	Permitting of research and exploration activities, drilling wells, establishing and using hydro infrastructure;	
to evaluate exploration, research and projects for construction of irrigation system for pastures, crops and hay fields, and report to the central government organizations in charge of nature and environment and agriculture;	to evaluate exploration, research and construction projects of irrigation systems for pastures, cropping and hay fields	
to decide on water uses in excess of 100 m³ per day	to conduct regular monitoring on the decisions and authorizations for water uses in excess of 100 m³ per day by River Basin Authorities and aimag and city departments for nature, environment and tourism	
	to allocate and limit water use or temporarily prohibit the use of water resources during droughts and water shortages and desertification; and habitat restoration in river basins where its natural restoration cycle has degraded.	Although the need was obviously there MNET never used its mandate to allocate and limit water use for industrial purposes or temporarily prohibit use of water resource for water resources and habitat restoration in river basins where its natural restoration cycle has degraded. Therefore, this mandate is now transferred to the Water Authority. An attempt is made to harmonize water management with land use management.
	to develop and adopt standards for the water quality of natural springs used for health treatments	The relation between the use of natural springs protection has been incorporated in the new Water Law.
	to authorize and decide on the use of natural springs for industrial purposes	
	to develop proposals for assessing the maximum of available water resources by each river basins	

The latest organization structure of the Water Authority is shown in Figure 8. The total number of staff in 2011 was some 41 persons, excluding the part-time staff of the Board of Professionals. The Director of the Water Authority has appointed a Board of Directors consisting of 8 senior staff members including the accountant to act as his management team.

The Management of the Water Authority is supported by an advisory body: the Board of Professionals composed of 8 part-time members, selected from the Water Authority and from outside. The members are appointed by the Director of the Water Authority and selected on the basis of their professional credentials. The Board of Professionals advises the Director on request and prepares decisions that need to be taken by the Water Authority management.

At present the Water Authority is preparing a modification of the Internal Regulations, the Bylaw and the structure of the Board of Professionals for it to be re-established as the Water Resources Council introduced by the new Water Law (2012).

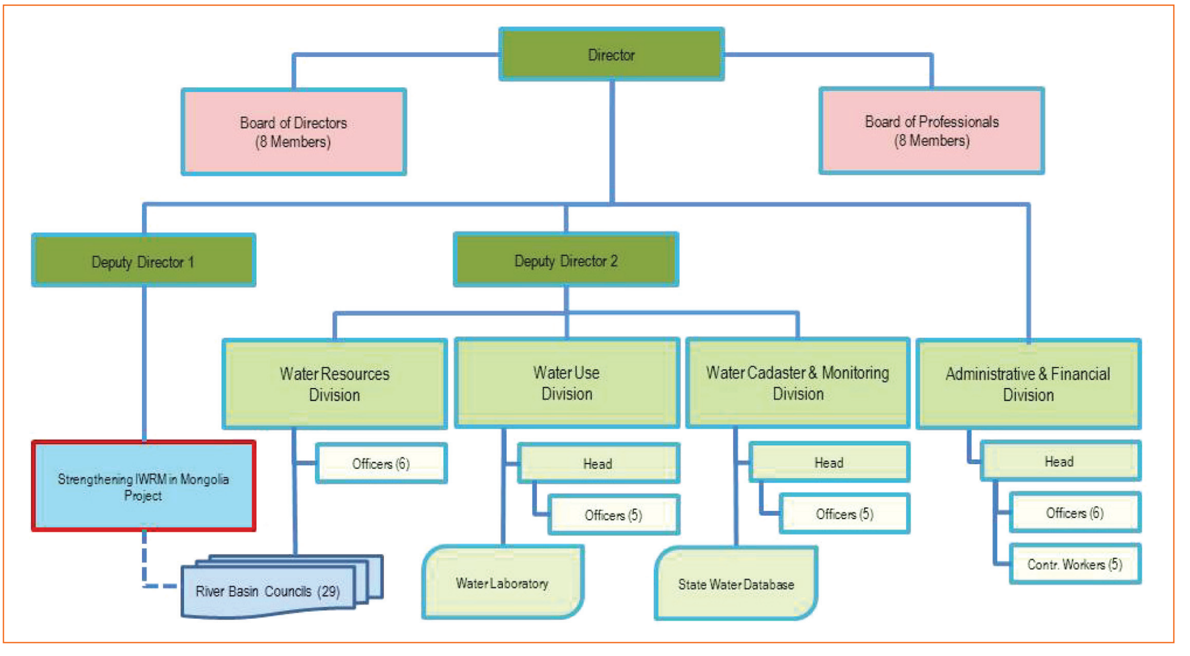


Figure 8. Organizational structure of the Water Authority (2010)

A major activity of the Water Authority at present is the "Strengthening IWRM in Mongolia" project (2009-2012) that aims to prepare and support the Water Authority in using an integrated water resources management approach. Among others the project is involved in setting up RBCs and in establishing a joint MSc course for IWRM at three cooperating universities.

Since its establishment in 2005 the number of staff of the Water Authority has more than doubled from 16 to 35 by 2012. More than half of the Water Authority staff is engaged for administrative tasks under the Administrative and Financial Division. This is quite an imbalance in staff deployment.

A financial analysis of the Water Authority's budgets reveals that the funding from the State Budget multiplied more than tenfold since the establishment from MNT 56mln. in 2005 to MNT 637mln in 2012. Income generated from licensing professional organizations on water, providing mining companies with professional authorization and other direct services such as house renting is used to cover the Authority's expenses. The total income from direct services increased from MNT 24.5mln in 2005 to MNT 85mln in 2011, but a sharp decrease was recorded in 2009 to MNT 5.6mln when the WA's Water Economic Centre was dissolved.

The expenditures of the expanding organization more than tripled since 2005 from MNT 74.7mln to MNT 244.8mln in 2011.

The Water Authority's main activities are:

- once every 4 years conduct a national water inventory for national level and once in every two years at aimag level and annually at soum level
- control state funded hydro-geological research plans and tender documents, and receive related reports
- receive groundwater exploration and research reports and approve groundwater availability estimates
- authorize water use (mainly for mining companies)
- make recommendations for Environmental Impact Assessment studies
- authorize designs for irrigation facilities
- organize construction of state funded water reservoirs
- licensing professional water organization
- managing the water database and cadastre
- prepare water related laws, regulations, standards and norms
- organize professional trainings for water sector specialists
- resolving trans-boundary water issues

Other Ministries and agencies, research institutes and universities

Besides the Ministry of Nature, Environment and Tourism there are seven other Ministries that fulfil important roles in the water sector management. In Table 6 a summary overview is given of the most important organisations involved in water management and their main role.

Table 6. Other Ministries and government bodies playing an important role in the water sector (2010)

	Ministry / Agency	Main role in the water sector
1	Ministry of Roads, Transport, Construction and Urban Development	• urban water supply (UB and aimag centres) • flood protection • major construction projects
2	Ministry of Food, Agriculture and Light Industry	• water supply for agriculture (irrigation); • rural water supply (soum centres and herders); • water supply for industries
3	Ministry of Mineral Resources and Energy	• infrastructure (including water) for mining industry • hydro-power
4	Ministry of Health	• water quality related to health issues
5	Ministry of Finance	• allocation of budgets for water resources protection, restoration and other water related measures • collection of water use fee
6	Ministry of Defence	• water supply for military bases • protection of water sources and water infrastructure of national strategic importance against external threats
7	Ministry of Education	• education and research in the field of water and environment
8	State Special Inspection Agency	• patrolling • enforcement • monitoring
9	Local governors and parliaments	• land use management and land use issues

In addition to public administration and technical government organisations there are also research institutes, laboratories and universities who play a role and their function is essential for decision making, policy development and implementation in the water sector. Table 7 summarizes the role in water management of the most important of these institutes and organisations.

Table 7. Main institutes and other organisations playing a role in water management

	Institution/ Organization	Tasks in the water sector
1	Institute of Geo-Ecology of the Mongolian Academy of Science	• conduct water related research; • operating a water chemical laboratory; • research on water ecology
2	Institute of Meteorology and Hydrology	• manage the surface water monitoring network; • carry out research related to surface water
3	Public Health Institute	• Research on health-related water quality • sanitation issues
4	National University of Mongolia	• train hydrologists for the water sector
5	Mongolian University of Science and Technology	• train hydro-geologists, geo-ecologists and water service engineers for water sector
6	National University of Agriculture	• Train agricultural engineers and hydro-construction engineers for the water sector
7	University of Eco-Asia	• Train ecologists for the water sector
8	Central Laboratory of Environmental Monitoring	• Research on environmental qualities (soil, water, air, etc.)
9	Training and Research Centre for IWRM at the Mongolian University of Science and Technology	• train specialized water engineers; • conduct water related research
10	Water Research Centre of the National University of Mongolia	• provide short training courses; • international cooperation; • carry out water ecology studies

3.1.2. Public administration at local level

Local governments

Most ministries and also a number of government agencies have a representation at the local levels. These local offices of the ministries are answerable to their ministry but also to the local (aimag or soum) Governor. The relevant local representations of ministries and agencies are discussed separately hereafter. The key role of the local Governors is preparing budgets for implementation and obtaining approval from the Citizens' Representatives' Khural for activities like water harvesting, water resources restoration and effective use, protection of water quality, and prevention from water-related disasters. The Governors are also the ones mandated to issue all sorts of licences and permits within certain limits; usually after requesting a professional assessment from the relevant departments.

Aimag[2] level Departments of Nature, Environment and Tourism

At aimag level the Ministry of Nature, Environment and Tourism is represented by the Departments of Nature, Environment and Tourism that, amongst others, are in charge of water issues. The Departments report on water issues to the Governor office, the Ministry of Nature, Environment and Tourism and the Water Authority. According to the Water Law (2004) aimag level Departments of Nature, Environment and Tourism are responsible for:

- monitoring the implementation of legislation and policies on water
- monitoring water resources utilization, habitat restoration and protection
- maintaining the aimag's water database
- mandated to authorize water use of 50-100 m^3/day

2 'aimag' level in this context also includes the urban equivalent: the 'city' level

Usually the aimags' departments of Nature, Environment and Tourism employ only one officer, the Environmental Inspector. The Institute of Meteorology and Hydrology, also part of the Ministry of Nature, Environment and Tourism, deploys staff in the aimags to carry out surface water discharge measurements and meteorological measurements, on a daily basis. These offices report to National Meteorology and Environmental Monitoring Agency and on a monthly basis to the Governor office.

After the government restructuring in August 2012 some of the names of the institutions mentioned have changed, but except for the Water Authority' dissolution the situation as described has not changed essentially.

Soum[3] Environmental Rangers

At soum level the Environmental Offices are responsible for proper water resources use and protection. Usually the Soum Environmental Office consists of one Ranger only. The Water Law (2004) mandates the Rangers to authorize water uses less than 50 m^3/day, however, in practice this has never happened and in the Water Law (2012) this mandate was replaced by assigning to the Environmental Rangers the responsibility to formalize water use contracts based on the water use permits. The Environmental Rangers are also responsible for monitoring payment of water use fees and pollution fee. The Rangers report to the Protected Areas administration or, if not available, to the aimag level Department of Nature, Environment and Tourism.

The Soum is the smallest administrative unit where line ministries and agencies have a representation (the Bagh level administrations do not have technical capabilities). This places the Rangers at the first line of contact between the citizens and the government in the context of implementing IWRM. The number of Rangers however is insufficient to adequately monitor water use and protect water sources. In total a little more than 600 Rangers are deployed, 225 of these are exclusively deployed in and for Special Protected Areas. This leaves an average of about one Ranger per soum for monitoring and other tasks. In absence of Rangers instances have been recorded where State inspectors carry out the tasks of the Rangers.

After the government restructuring in August 2012, some of the names of the institutions mentioned have changed, but the situation as described remains valid.

Offices and Departments of other Ministries and Agencies at local level

Also other Ministries and Institutes have local offices that carry out their tasks in water management. Table 8 presents an overview of other Ministries and Agencies represented at the local level and/or avail over water management information and data at the local levels. Several ministries were affected by the government restructuring in August 2012. Details of how these changes trickle through to the delegated offices at the local administrative levels have not become available yet. An overview of the changes in the ministries is given in Annex 8 and it may be expected that the situation at the local level will essentially not change much.

[3] 'soum' level in this context also includes the urban equivalent: the 'district' level

Table 8. Overview of local representations of other Ministries and Agencies having a role in water management (2010)

	Ministry / Agency	Representation at Aimag/Soum levels	Water management data on:
1	Ministry of Roads, Transport, Construction and Urban Development	• Aimag Department of Land relations, Construction & Urban Development • Soum Land Office	• urban water supply; • urban waste water treatment • flood protection; • major construction projects; • land use
2	Ministry of Food, Agriculture and Light Industries	• Aimag Department of Food, Agriculture and Light Industries • Soum Agricultural Office	• rural water supply • agriculture water supply • irrigation
3	Ministry of Mineral Resources and Energy		• groundwater • hydro-geological maps • hydro power • water use thermo power plants
4	Ministry of Health	• Aimag Health Department	• water quality
5	Ministry of Finance	• Aimag Tax Division • Soum Tax Inspector	• collection of water use fee and payment
6	Ministry of Defence		• water supply of military bases
7	Ministry of Education		• field research on water and environment
8	State Special Inspection Agency	• Aimag Special Inspection Department • Soum Special Inspector	• violations and conflicts

Decentralisation being an important element of IWRM has already established quite well in Mongolia as illustrated in Table 8. Ministries and Agencies heavily rely on their local offices for implementation of policies as well as for data and information. Decentralisation of responsibilities is most advanced in the cases of rural and agricultural water supply through the Aimag Departments of Food, Agriculture and Light Industries and the Soum Agricultural Offices, and land management through the Aimag Departments of Land relations, Construction & Urban Development and the Soum Land Offices. Mostly the local Governors do actually take the decisions, but these local departments and offices provide the Governors with all the data and information and prepare the technical details for these decisions. On some issues the Governors' decisions need sanctioning by the Citizens' Representatives' Khurals. The task of the State Inspection Agency is decentralized as well and involves controlling and monitoring the state of water.

Although the Aimag Tax Office is charged with collecting water fees etc., local control on payment of these fees lies with the Inspection Offices. The efficiency and effectiveness of this arrangement is unknown, but appears to depend highly on close cooperation between the two offices at the local levels, which is something that is structurally embedded in the system.

3.1.3. River Basin Organizations

River Basin Councils

The Water Law (2004) introduced the river basin approach and Article 19 provided the legal basis for River Basin Organizations. The Law specifies the composition of the River Basin Council, as it is called and the following functions:

- to formulate a river basin plan and monitor its implementation
- to monitor adherence to the water user's obligations on water restoration in accordance with the environmental impact assessment
- to evaluate the intention to revoke water use licenses for those who failed to comply to their obligations

- to participate in organizing protection and afforestation activities of water sources supported or initiated by citizens' or professional organizations

River Basin Organizations are further detailed in the Ministerial Regulation No 187 (9 June 2006). The Ministerial Regulation No 187 stipulates approval of the rules on River Basin Councils. Its purpose to clarify and arrange in a unified manner the operational functioning of RBCs. Unfortunately this particular Regulation does not really clarify everything and on some important points deviates from the Water Law (2004) as follows:

- The Regulation assumes that the River Basin Council is established on request of a group of persons to the Government or to the environmental agency in the aimag or capital city.
- It introduces the option for a Sub-basin Council following the same procedure as for a Basin Council.
- Representation is prescribed as: the authorized Government, citizens' representation (Khural) and administration, environmental and professional inspection agencies, agriculture, industry, citizens, researchers, rangers, NGOs delegates.

In the context of the "Strengthening IWRM in Mongolia" project the MNET has established the boundaries of 29 river basins covering the whole of Mongolia (see Figure 9). Some 10 of these basins in the south of Mongolia (Groundwater Basins) do not have surface water drainage outside the basin. In these basins, groundwater is of prime importance. In the other basins, surface water plays a more dominant role. By January 2012 a total of 6 River Basin Councils and 11 sub-councils had been established since 2006 (see Annex 6). These River Basin Councils have been established with support from international donor organizations, NGOs and projects; they are young organizations that still have to further develop their capabilities in the field of IWRM.

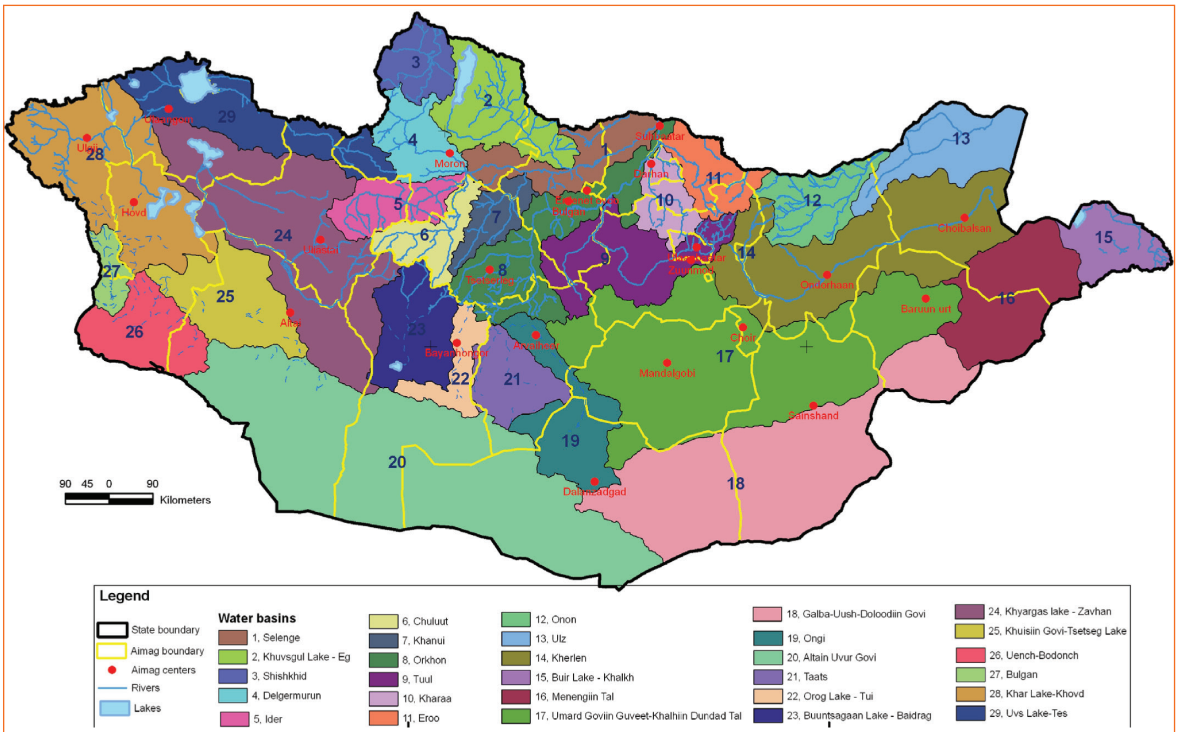


Figure 9. River Basins (29) in Mongolia

When applying the Water Law (2004) to the establishment of River Basin Councils the law proved quite ambiguous on certain points:

- the law does not clearly specify the status and type of River Basin Councils e.g. whether it is a government organisation or an NGO, etc.
- although the RBCs are to address institutional arrangements through the River Basin Management Plans by including NGOs and local communities in the decision making processes, the scope and mandate of the River Basin Council are not clearly defined
- on the one hand the law seems to focus the mandate of the River Basin Council on awareness raising and enhancing public education, while on the other hand the focus seems to be on coordinating all stakeholders in addressing water problems through the River Basin Management Plans
- the mandates, duties and responsibilities of the River Basin Councils and the State Specialized Inspection Agency considerably overlap with regard to enforcing the law

As a consequence the role of the River Basin Council remained quite unclear.

The new Water Law (2012) much better clarifies the role of the River Basin Councils as ensuring public and user involvement in water management and to reflect their opinions in the water management. Article 2, clause 20 of the Water Law (2012) stipulates that proposals for the establishment of River Basin Councils and the Bylaws of River Basin Councils shall be approved by the Minister of Nature, Environment and Tourism.

The new Water Law (2012) defines the role of the River Basin Councils by their main task, which is to engage citizens in local water management for protection, effective use and restoration of water resources. The River Basin Councils have the following responsibilities:

- ensure decisions regarding the appropriate use and protection of water resources are taking into account the citizens` comments and opinions
- comment on all major development plans that have an effect on water such as mining, water use and storage, dam constructing, drainage systems, etc.
- monitor and control on the implementation of River Basin Management Plan by the River Basin Authorities and initiate procedures at competent offices to eliminate unlawful activities
- monitor implementation of water user's obligations regarding water restoration in accordance with the water use contract and the EIA
- monitor performance of a regime for special and ordinary protection and sanitary zones;
- participate in organizing protection and afforestation activities of water sources supported or initiated by citizens' or professional organizations
- recommend to cancel a project or design for constructing water infrastructures when authoritative evaluations report adverse impacts on water resources
- recommend to competent officials and organizations the withdrawal of authorizations for water use issued by the River Basin Authority

The Water Law (2012) precisely states that River Basin Councils shall consist of members representing local administration, environment department, professional inspection agency, non-government organizations, soum and district citizens, water users, scientists, researchers, and professional organization on water issues.

River Basin Authorities

River Basin Authorities were first introduced in the new Water Law (2012). River Basin Authorities are to be established in the (29) River Basins and operate with professional support and guidance from the Water Authority. The River Basin Authorities are responsible for implementation of all water management activities within the basin. The River Basin Authorities' structure and Bylaw will be approved by the Minister of Nature, Environment and Tourism.

The tasks and responsibilities assigned to the River Basin Authorities are:

- to develop draft river basin management plans
- to provide cross-sector and stakeholder coordination at different level that is needed for effective implementation of the River Basin Management Plan and to monitor its implementation
- to provide local governors and local parliaments at the various levels with professional guidance and support
- to annually organize a surface water inventory within the river basin in close cooperation with the local administration and to report the outcome to the Water Authority
- to operate and maintain a river basin data base and to disseminate required information to the public
- to process and prepare a technical assessments for drilling requests for ground water wells and for construction of drainage systems from individual citizens and economic entities for forwarding to the competent. Assessments are to be made in the context of the River Basin Development Plan and the basin database requires updating accordingly
- to prepare charges for water use fee and pollution fee, based on the law;
- to determine the locations for water supply abstraction and for disposal of waste water within the river basin
- to prepare technical recommendations for cancelation of licenses for water use and/or disposal of waste water from citizens and economic entities, who violate the legal requirements for water use and disposal of waste water;
- to continuously monitor the total available water resources for use as well as the water use within the basin;
- in close cooperation with the local administrations prepare proposals for establishing a River Basin Council and to submit it to the Water Authority
- to estimate the needs for local protection of rivers, lakes and ground water deposits in the basin.

A very important responsibility assigned to the River Basin Authority is to submit professional recommendations to the competent authorities for the licensing of exploration and exploitation of mineral resources within the basin areas. This places the water sector in a decisive position with regard to the local implementation of policies and plans of the other sectors.

The Water Authority before it was disbanded was drafting the Bylaws for the River Basin Authority and proposals for its organizational structure to be approved by Minister of Nature, Environment and Tourism. A tentative organisational structure of the River Basin Organisations is presented in Figure 10.

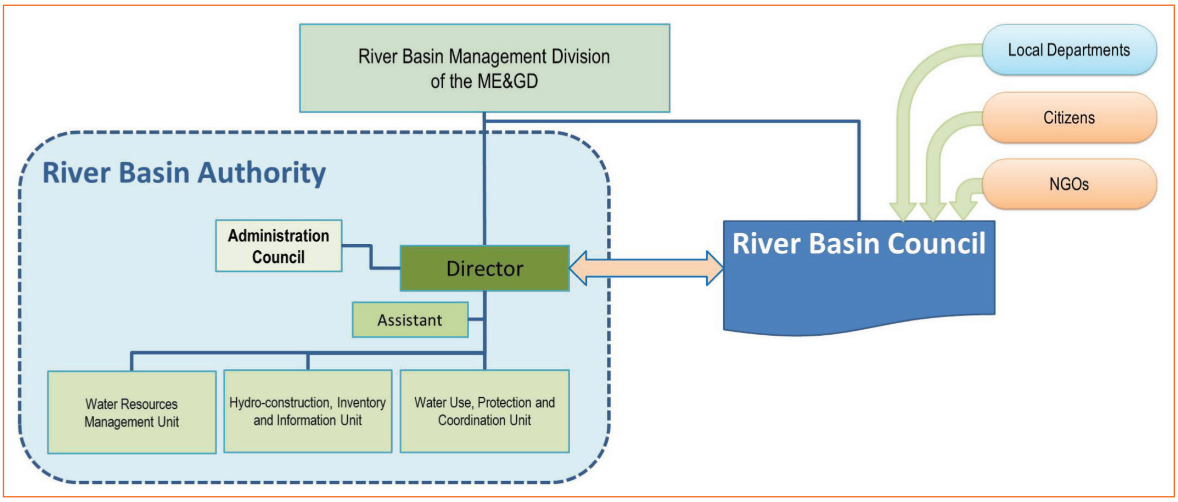


Figure 10. Tentative organisational structure of River Basin Organisations

3.1.5. The private sector and (non-profit) Non-Government Organisations

More than 20 years after the introduction of the free market economy in Mongolia, private sector involvement in the water sector is still rather limited. This is partly due to a relatively low number of private companies having matured within these twenty years. Besides that business in the water sector requires substantial investments from the business organizations themselves and financing business investments still meets considerable obstacles

Private companies in the water sector are mainly consultancy firms and contractors. Consultancy firms are engaged in feasibility studies, design work, EIAs, etc. and contractors for surveying, mapping, exploration, drilling, construction and installation, etc. These private sector companies obviously play a vital role in the water sector, but since the companies do not take the decisions on water policy and water management (although they may be contracted to carry out specific studies that will support the decision-making process), but merely carry out works they have been contracted to do, these are not considered 'actors' and are not further discussed here.

For the future the private sector involvement in water management may need to be increased to complement the state efforts in the water sector. In particular various forms of public-private-partnerships (PPP) would be an option, for instance for constructing, operating and managing water supply and sewage facilities. In some aimags wastewater collection and treatment operations have been privatized but with varying results.

Besides these there are a few companies that are more than just contractors and make management decisions, in particular water supply and sewage companies and the future MGL Water that has recently been established by Government Order No.335 of 23 November 2011.

Water Supply and Sewage Companies

Of the water supply and sewage companies the best known and largest one is USUG in charge of the water supply and sewerage for Ulaanbaatar city. USUG is a City owned state property organization. Similar companies (generally referred to as Public Utility Service Organisations - PUSOs) already operate in some of the aimag centres and other major towns in Mongolia.

The City owns the infrastructure of the water supply and waste water systems; the Water Supply and Sewage Companies only operate the systems and their duties are to provide the city residents with a reliable supply of drinking water that meets the drinking water standards and to treat and dispose of the waste water in such a way not to adversely affect the ecological balance.

The Ulaanbaatar Water Supply and Sewage Company USUG is headed by a director and is organized in 4 administrative departments and 7 divisions. The structure of the Water Supply and Sewage Company is a matrix organisation as shown in Figure 11.

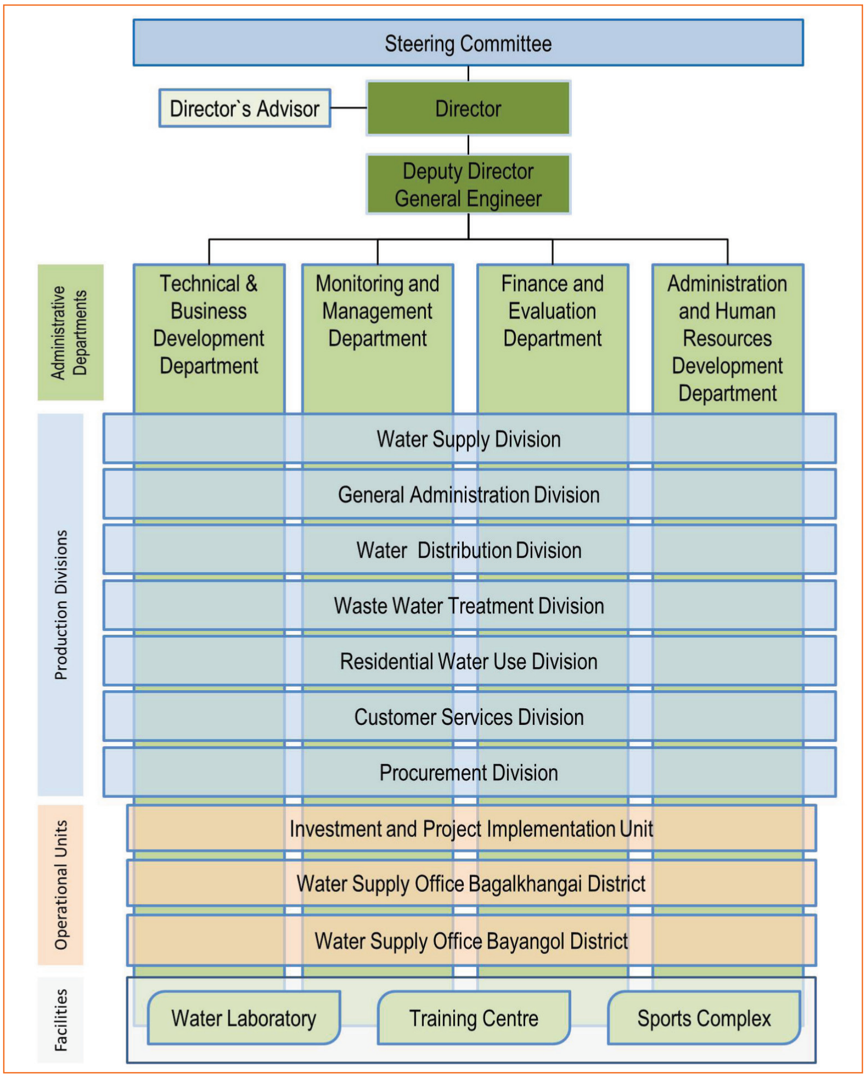


Figure 11. Organisational structure of USUG

Water Supply and Sewage Companies are expected to be financially self-contained with respect to operation and maintenance of the systems. However USUG does receive support from international donor organizations and projects and its daily operations are largely financed form the state budget. This is an indication that the mechanisms for covering the costs of water supply services within the current legal environment are inadequate. A major contributor to USUG's unprofitability is the condition of the water supply and sewage infrastructure, which is not up to standard and requires substantial investments to improve the effectiveness and efficiency of the services.

USUG does not provide water to individuals directly, but through water Housing Services Companies (OSNAAG) that are responsible for distributing drinking water to the individual. An OSNAAG services one or several housing blocks and is also responsible for the maintenance of the distribution system under its care; they are charged by USUG for water supplied and they in turn charge the residents. Areas without house connections are served through water kiosks, which are either connected to the central distribution system or supplied by water trucks. A small number of water kiosks operate a borehole.

'Монгол Ус' (MGL Water) state owned private sector company

In 2011 the state owned private company "MGL Water" was established to operate and maintain all of the state owned major water infrastructures. The legal embedding of 'MGL Water' is based on Article 9.5 of the Law on State and Local Property, Article 36.7 of the Water Law (2004), Article 3.5.7 of the National Water program (Parliament Resolution 24) and measure 5.6 of the Action Plan of the NWP (Government Resolution 304 of 2010).

The Minister of Nature, Environment and Tourism and the Head of the State Property Office need both to approve the draft Bylaw for the 'MGL Water', which will assign it the task and responsibility to manage major water infrastructures like irrigation systems, drainage systems and reservoirs and groundwater deposits on behalf of the Government. It is expected that the licensing of groundwater abstraction for drinking water supply, for which not any government organization is responsible at this moment, will be included in the responsibilities of the 'MGL Water'. The draft Bylaw proposes an organizational structure for the public owned private company 'MGL Water' as shown in Figure 9.

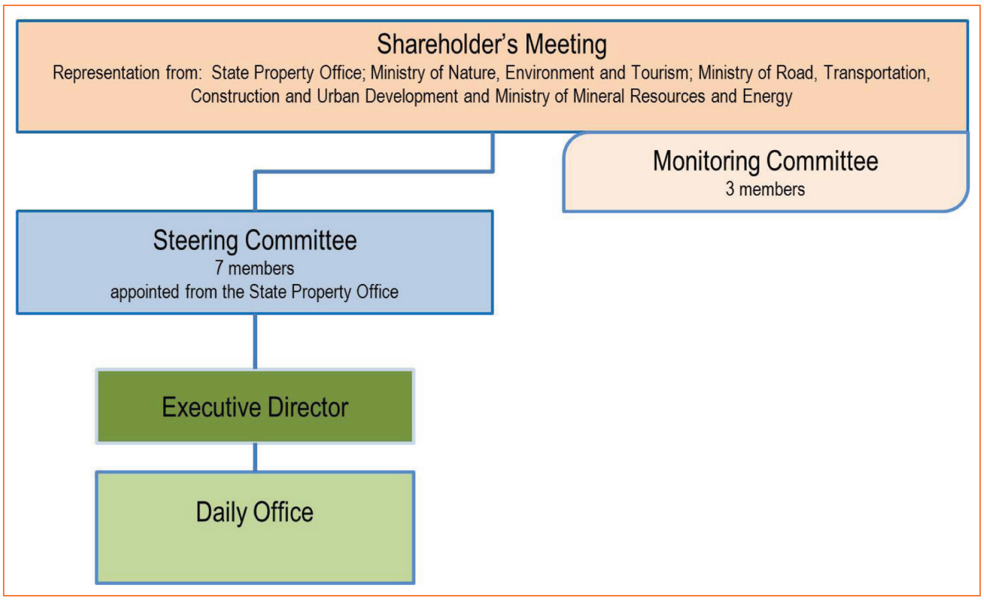


Figure 12. Organisational structure of 'MGL Water'

The main tasks of the 'MGL Water' are:

- to provide a reliable water supply for water users and consumers and to restore water resources
- to train water sector specialists and to ensure proper working condition and social security for them

- to operate and maintain the main water infrastructures for drinking water supply, industrial (mining) water supply and agricultural water supply; to manage the major water infrastructures like irrigation systems, drainage systems, reservoirs and groundwater deposits on behalf of the Government and act as the government shareholder
- to introduce modern and technically advanced technologies in the water sector
- to implement water saving policies for water resources use, water transfer, water distribution and water consumption
- to frequently monitor the operation of facilities with regard to economic efficiency and safety measures
- on decision by the Steering Committee, based on the State Property Agency's order, to hold permits for exploitation of those ground water deposits that have been explored under the state budget
- regulate entities who are re-exploring groundwater resources and reassess groundwater deposits that have already been explored and assessed under financing from the state budget
- Water MGL will represent the responsibilities of the Government; the Government's share of the profits from operating water infrastructures, irrigation systems, urban water supply resources infrastructures will be kept by Water MGL

After the government restructuring in August 2012, some of the names of the institutions mentioned may have changed, but the situation as described remains largely valid.

Civil Society Organizations

Environmental protection and management has long been the realm of Government organizations till the Law on Environmental Protection was amended encouraging involvement of non-government organizations and civil society organizations. The Ministry of Nature, Environment and Tourism proclaimed 2008 the year of "Increasing involvement of the NGOs in environmental protection" and the first dialogue meeting of the Government and the NGOs in environmental field was organized jointly by Ministry of Nature, Environment and Tourism and the Parliament Standing Committee on Environment, Food and Agriculture. The aim of the dialogue was to build and strengthen trust between the Government and the NGOs, to jointly address constraints in the environmental field and to identify ways to cooperate in the future.

Since then the involvement of NGOs and community organizations has been steadily increasing. By 2009 the number of workers for environmental protection in civil society organizations was estimated to be 4 times the number of civil servants serving in the environmental field (see also Table 9).

Table 9. Civil society organisations for environmental protection (Dec. 2009).

Category	Number of Organisations	Members and workers
Non-Government organisations	549	2850
Professional companies	501	1986
Environmental community groups	263	8793
TOTAL	1279	13629

Out of these categories the NGOs are the most active and by far the most influential with respect to environmental protection. By December 2009 549 environmental NGOs had been registered their distributed over the country as shown in Figure 13.

Figure 13. Distribution of environmental NGOs across Mongolia

In some developed countries NGOs play a leading role in environmental management. For instance in Japan local NGOs execute environmental functions on behalf of the Government implementing agency. Involvement of the NGOs in environmental field in Mongolia has been enhanced over past decade. Examples are the successful implementing of the Khustai National Park management plan by the "Mongolian Environmental Protection Union" and "Khustai Centre" NGOs; the development of the management plan for the Ikh Nart Natural reserve for management of the area on behalf of the local government by the "Argali Centre" NGO. Another case is the successful implementation of the comprehensive management measures in Gun Galuut locally protected area under the funding of the Ministry of Nature, Environment and Tourism by the "Community Union" NGO.

In 2009, environmental NGOs were actively involved in the development of at least five environmental laws. Moreover, after many years of tireless pressure by the Movement of Mongolian Rivers and Lakes, which was established by combining the forces of ten local NGOs, the Law on Prohibition of Mineral Prospecting Exploration in River Basin Areas and Forest Areas was passed by the Parliament in 2009.

From 2010 till 2012 the Ministry of Nature, Environment and Tourism focussed on strengthening the local NGOs to make them self-sustained organizations for environmental protection. The cooperation among government organizations and NGOs has reached a next level of collaboration as illustrated by the request to the NGOs to present their reports during the Second dialogue meeting of the Government and the NGOs in environmental field.

Most NGOs focus on a specific aspect. A breakdown of the number of NGOs active in the specific fields of environment is given in Table 10.

Environmental NGOs have joined forces and bundled their resources in umbrella organisations to increase their effectiveness and efficiency. Two of the more important umbrella organisations are discussed hereinafter.

Table 10. Fields of work the environmental NGOs focus on

Specific field of work	Number of Organisations	%
Forest	114	20.8%
Fauna and Flora	100	18.3%
Ecological education	89	16.2%
Mining and pasture land	72	13.2%
Soil and land	52	9.4%
Environmental information dissemination	51	9.4%
Student and youth unions for environment	18	3.2%
Environmental pollution	16	3.0%
Protected area and tourism	14	2.5%
Air	13	2.3%
Law and legislation	10	1.8%
TOTAL	549	100%

Mongolian Environmental Civil Council

The Mongolian Environmental Civil Council was first established with 9 members in response to the "First dialogue meeting of the Government and the NGOs in environmental field" and a cooperation agreement was signed between Minister of Nature, Environment and Tourism and head of the Mongolian Environmental Civil Council.

The Mongolian Environmental Civil Council now serves as an umbrella organisation for more than 200 national and local NGOs who are organised in thematic units (see Figure 14)

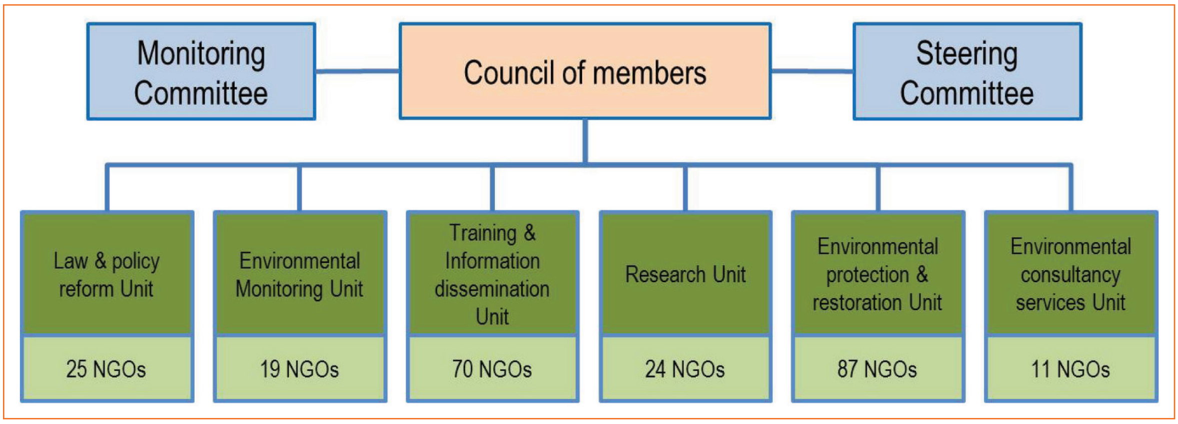


Figure 14. Organizational structure of the Mongolian Environmental Civil Council

The Mongolian Environmental Civil Council aims to ensure overall coordination and cooperation amongst the environmental NGOs and to develop cooperation with the government and international organizations for addressing environmental issues. Since 2008, the Mongolian Environmental Civil Council has been actively engaged in environmental policy development and decision making processes. They are represented in several organizations such as the Minister`s Council of the Minister of Nature, Environment and Tourism, National Desertification Committee, the Steering Committee of the Millennium Development Fund and the Environmental Evaluation Committee.

Moreover, 4 members of the Mongolian Environmental Civil Council are certified State Inspectors.

With the Water Authority and the City Department of Nature, Environment and Tourism the Mongolian Environmental Civil Council entered into a cooperation agreement for 2009-2012 to strengthening water resource management.

Coalition of Civil Movement for Environmental Conservation

Another umbrella organisation for environmental; NGOs is the Coalition of Civil Movement for Environmental Conservation, a coalition in which 12 Environmental NGOs join forces. The Coalition of Civil Movement for Environmental Conservation aims to correct government policies and decisions that have an adverse impact on the ecological balance. Their goal is to protect the basic human right to live in a healthy and safe environment against violations. The objectives of the Coalition of Civil Movement for Environmental Conservation have been formulated as follows:

- to increase public participation in environmental protection
- to educate the public enhancing their legal and ecological knowledge
- to establish public monitoring systems for responsible and environmentally friendly mining
- to support and promote environmentally friendly technology
- to give incentives to organizations and individuals, who contribute to environmental protection
- to lobby the government for policies that enable ecological governance

The Coalition of Civil Movement for Environmental Conservation serves as an umbrella organisation for 12 national and local NGOs. Its organizational structure is presented in Figure 15.

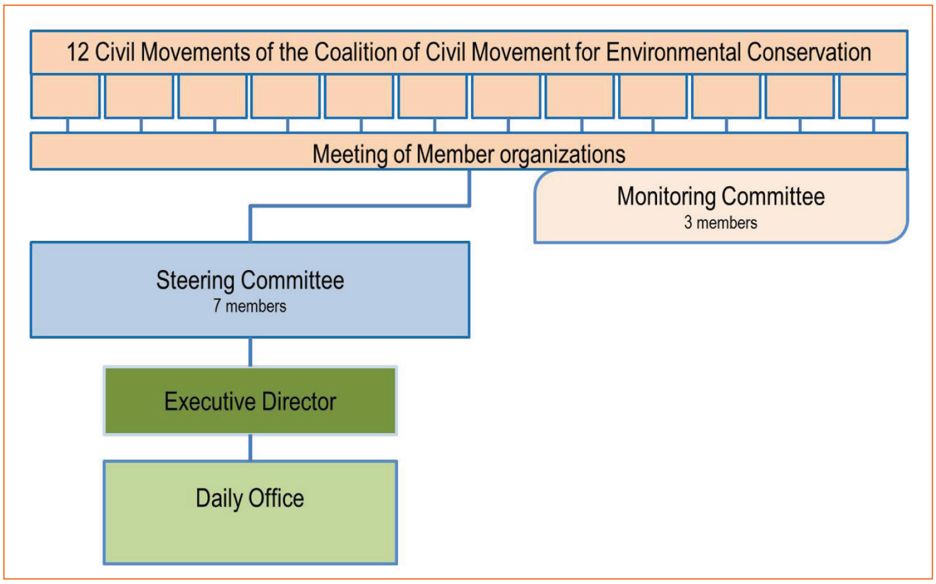


Figure 15. Organizational structure of the Coalition of Civil Movement for Environmental Conservation.

4. Stakeholder analysis

4.1. Introduction

The stakeholder and institutional analysis is carried out in the context of IWRM and based on the outcome of a number of activities:

- Literature study
- Structured interviews with key actors
- Stakeholder survey
- Application of MIMAT-software for data management

Water management is not a stand-alone activity. It is closely interrelated to land management and environmental management. Any management decision and subsequent actions in each of these sectors are likely to have an impact on the other sectors. For example, intensifying the use of fertilizers and/or pesticides is bound to adversely affect the quality of ground water and surface water downstream, which in turn is likely to have detrimental effects on the ecology. Likewise, cutting down forests or construction of cities is likely to cause major changes in the hydrology and the bio-diversity of the watershed and beyond. Similarly, construction of a hydropower dam is an intervention that causes major changes upstream and downstream, altering the ecology and land use options.

In the course of introducing IWRM it is imperative to look at water management in close relation with land management and environmental management. It is quite obvious that deficiencies in the land or environmental sectors constitute potential threats to the water resources, which cannot always be remedied by water management measures alone, but are often best tackled through combining water management measures with land and/or environmental management measures. In the same way, any water management measure is likely to affect land use options and impact the environment in either a positive or a negative way.

Water management is about delivering water in adequate quantities and of a desired quality to where the needs are. To make that possible the water sector takes care of the necessary infrastructural works, capable and sufficient human resources and adequate financial and material resources. Usually the water sector is also dealing with measuring, monitoring, forecasting and planning and sometimes with fee collection and enforcing. IWRM adds to conventional water management a focus on the decision-making processes in water management. IWRM promotes integrated management processes involving all stakeholders. Such processes can only become effective and efficient in an "enabling environment" with a supporting "institutional framework" and having the proper "management instruments".

The transition from conventional, sector oriented water management to Integrated Water Resources Management requires adaptations in the enabling environment (e.g. political priority, legislation, etc.), the institutional framework (e.g. decentralization, devolution, delegation, etc.) and management instruments (e.g. monitoring, information sharing, training, etc.). Introduction of IWRM will be a step by step process, which in principle will never end – there will always be room for further improvements. The challenge is to identify those steps that are likely to have the greatest impact while having the best potential to be successful under the prevailing circumstances. This already implies that IWRM is not a standard recipe; the steps to be taken are not strict and prescribed, but are unique for every situation and every country at any given time. Thus a thorough analysis is needed of the institutional landscape as it exists. When we decide what form of integrated water management we desire and deem potentially successful, the necessary steps for institutional reform of the water sector can be defined to make that possible.

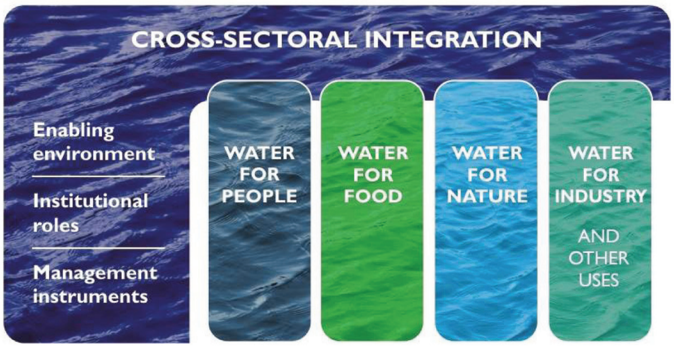


Figure 16. Common frame work for IWRM

The main characteristic of IWRM is its focus on strengthening cross-sector integration (see Figure 16), whereby the main sectors to be involved are the water sub-sectors: drinking water, water for food and agriculture, water for industry and energy and water for the environment. In most cases the prime concern of these sub-sectors is their water needs and water management primarily focusses on satisfying these water demands. However, at times (the lack of) water can also pose a threat and therefor defences against flooding and droughts need to be integrated in the management as well.

4.2. Methodology

The amount of data and information that comes in when assessing the institutional landscape for water management rapidly increases to overwhelming quantities. To maintain the overview it is necessary to approach the analysis in a very structured manner, avoid irrelevant details that divert the attention away from the main issues. Therefor it was decided to collect only data essential to the purpose of the analysis. Even when doing that it will be very difficult to make some sense out of the enormous amount of data.

MIMAT (Matrix-based Institutional Mapping and Assessment Tool) is a tool for managing all these data that can combine data in various ways to provide insight in specific aspects. With regard to IWRM we are foremost interested in:

- Are all necessary water management functions actually assigned and carried out; are there gaps and/or overlaps; are those who carry out a function actually mandated to do so and similarly are those mandated to carry out a specific function actually carrying it out.
- Do the entities responsible for a specific function have:
  - the necessary human capacity in numbers as well as in capabilities,
  - the necessary financial and material means

The institutional setting is analysed in the context of the IWRM principles:

- the principle of subsidiarity or decentralized versus centralized governance
- the principle of cross-sectoral integration or ‘coordinated management’
- the principle of stakeholder participation in decision making for water management

4.3. Analysis

The analysis of the institutional setting of water management in Mongolia is based on information that has been collected through a survey of all key actors in water management in Mongolia. The survey was carried out in 2010 and consisted of structured interviews with representatives of the key actors and the results are compiled in the Technical Report '*Institutional Analysis – Assessment of Actors in the Water Sector*'. The survey results were entered in the database of the MIMAT-software to produce matrices that visualize the relations in a manner that allows the structured analysis of the information.

For using MIMAT as the analysis tool it is necessary to define the following parameters (see also the description of MIMAT in Annex 2):

Actors. An actor is usually an organisation and not a person as the word may suggest. The term 'actor' refers to those who are affecting water management decisions, as opposed to the term 'stakeholder' referring to all those affected by water management decisions, whether positively or negatively (also see Box 2 on page 3). A total of 65 actors have been identified and included in the analysis. For a complete list of actors see Annex 3.

Families of Actors. In MIMAT all actors are categorized as belonging to either one of the four 4 families:

- State, e.g. public administration and line ministries
- Elected Bodies, e.g. national and local parliaments
- Civil Society, e.g. private sector, NGOs, Institutes, etc.
- IWRM Bodies, e.g. River Basin Organizations, etc.

▪ Categories of Actors. Within the Families of Actors the researcher has the freedom to define categories. For this analysis most categories were defined on the basis of the national and various local levels (see Annex 3)

Functions. All water management functions that need to be carried out in the context of IWRM have been defined and ordered in a logical manner. The same was done for land management functions and environmental functions – for as far as these functions have a bearing on water management. A summary of the functions is presented in Table 11 and the full list can be found in Annex 3.

Uses. The parameter 'Uses' allows MIMAT to differentiate between actors carrying out the same function for different purposes, e.g. the function 'designing water management interventions' is the responsibility of MFALI for rural water supply and of MRTCUD for urban water supply; this does not imply an overlap. Uses have been defined for water management, as well as for land management and environmental management for as far as they have a bearing on water (see Annex 3).

Scale. To analyse decentralisation of functions MIMAT uses the parameter 'Scale' under which we can distinguish the various administrative levels at which actors perform. Besides an administrative scale MIMAT also uses a natural scale, which is useful to distinguish functions confined within natural boundaries like desserts, protected areas, but most importantly river basins (see Annex 3).

The MIMAT analysis also includes an assessment of the actor's human resources, both in terms of number of staff and competence of the staff, the actor's material and financial resources for fulfilling each function as well as the overall performance of the actor with regard to each of the actor's functions. The assessment scores each of these as: Weak, Acceptable, Excellent or Unidentified. In should be noted that this assessment is only a momentary picture that is subject to changes. It further needs to be stated that the scoring is not entirely objective as there is no objective yardstick to measure these parameters so a judging system was used that is based on the opinion of the individual(s) representing the actor, and the expert opinion of the interviewer. Most of the scores have been cross-checked during the structured interviews with key actor. Although the results of the analysis cannot be considered an absolute and objective assessment of the performance of the actors; the outcome is nevertheless very useful to identify (potential) institutional constraints.

The outputs of MIMAT are various matrices that combine different parameters to visualize specific aspects of the institutional landscape. For this analysis the 'Function Dispersion Matrix' and the 'State Disengagement Matrix' have been used.

Table 11. Main functions and the number of sub-functions defined for IWRM in Mongolia

Water management		Land management		Environmental management	
Main functions	Sub	Main functions	Sub	Main functions	Sub
Water Policy Making	16	Land (Management) Policy Making	15	Environment Policy Making	16
Water Legislation and Enforcement	13	Land (Management) Legislation and Enforcement	8	Environmental Legislation and Enforcement	11
Water Resources Assessment and Monitoring	7	Land Resources Assessment and Monitoring	0	Environmental Resources Assessment and Monitoring	2
Water Demand Assessment and Projection	2	Land Use Needs Assessment and Projection	0	Environmental Demand Assessment and Projection	2
Water (Management) Planning, Design and Costing	12	Land(Management) Planning, Design and Costing	1	Environmental (Management) Planning, Design and Costing	10
Water Resources and/or Services Allocation	14	Land Services Allocation	0	Environmental Resources and/or Services Allocation	7
Water Services Provision	17	Land Services Provision	3	Environmental Services Provision	9
Water Resources and/or Services Pricing	7	Land Resources and/or Services Pricing	2	Environmental Resources and/or Services Pricing	6
Water Related Risk Management	12	Land-related Risk Management	6	Environment-related Risk Management	13
Water Information Management	9	Land Information Management	0	Environmental Information Management	2
Total	109	Total	35	Total	78

4.3.1. Function dispersion

The function dispersion matrices for water management, land management and environmental management functions are presented in Annex 5. The matrices show which actors are responsible for each of the management functions and for which particular 'use'. This allows for an analysis of overlaps and gaps in the functions carried out.

The function dispersion matrices also include the outcome of the performance assessments made for each function an actor carries out. Besides the performance also three potential constraints are assessed that may explain the assessed performance level. These include the available number of staff, the competences of the staff and the actor's material (equipment etc.) and financial resources for carrying gout that specific function. The assessment score is the result of the actor's own assessment combined with the expert's opinion of the interviewer and complemented with the information obtained from the structured interviews with key actors.

Assessments

Figure 17 presents a summary overview of the assessments carried out under the survey. Four parameters have been assessed:

1. the performance of the actor with respect to the specific function
2. the human resources available for performing that function
3. the competences of the human resources for performing that function
4. the available material and financial resources available to perform that function

Ratings are given on a qualitative scale: ‘Excellent’, ‘Acceptable’, and ‘Weak’. Cases where information was lacking the rating ‘Undefined’ is given. For some functions no actor could be identified.

The upper row in Figure 17 (Overall) shows the summary of all actors for all the functions they perform. Below that the results are presented for Water Management, Land Management and Environmental Management separately.

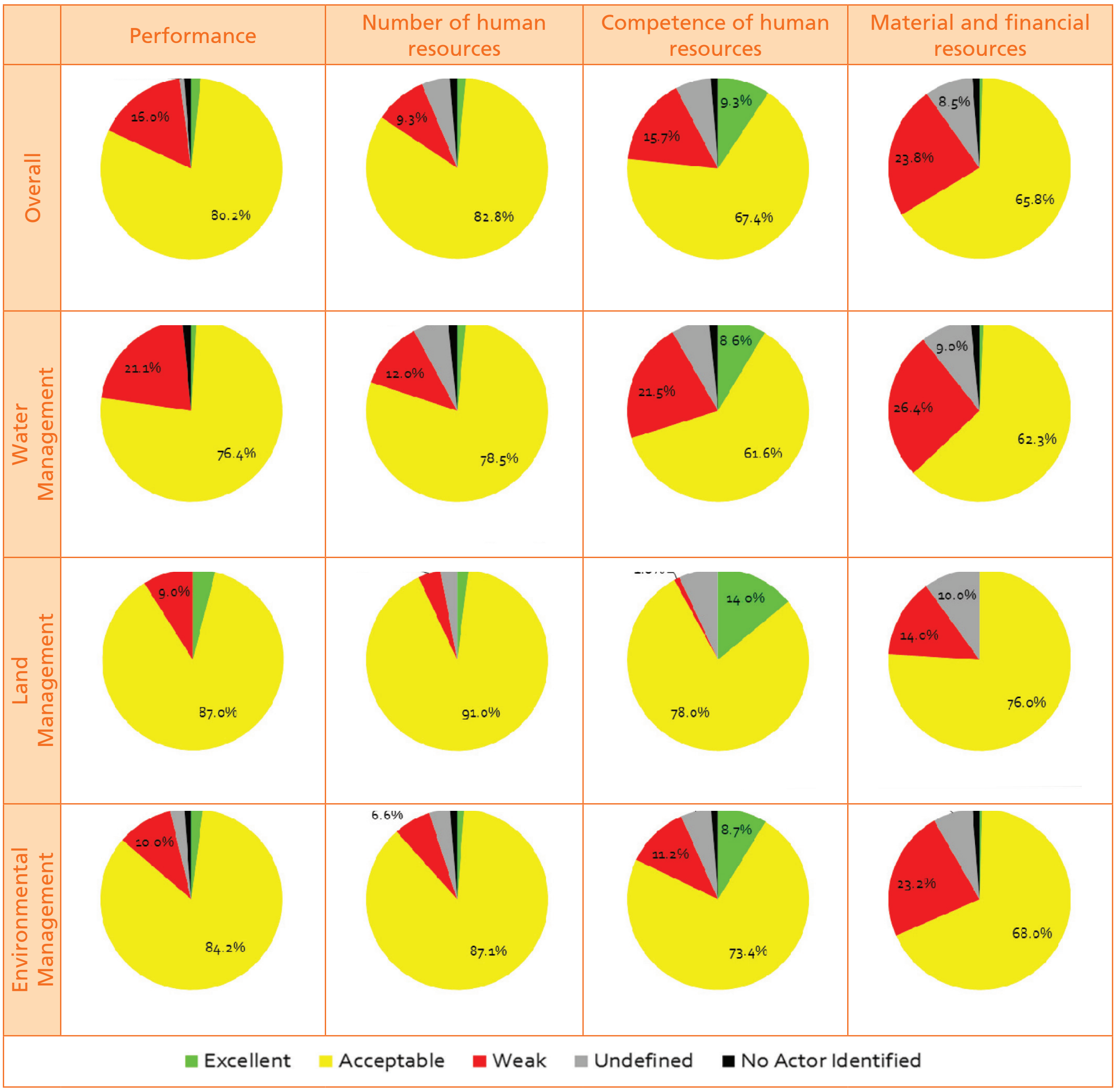


Figure 17. Summary overview of the function and actor assessments

In general it can be concluded that in more than 80% of the cases the performance of functions by actors is considered adequate (Excellent + Acceptable). The number of human resources is reported insufficient in less than 10% of the cases. However, quantity is not everything, more than 15% of the cases are judged that staff was not fully qualified or capable to perform their function. In an alarming high number of cases (almost a quarter) a lack of material, equipment or financial resources were constraining the performance for the function.

On all four parameters the land management functions score best, while the water management functions scores below average on all parameters.

In all three sectors (water, land and environment) the main constraints for optimal performance are reportedly their means and financial resources. In the water sector that is the case in more than a quarter of all the cases and also in environmental management this is a constraint affecting almost a quarter of the function implementation. A special case is the financing of the potential key IWRM organisations: the NWC, the WA and the RBOs. These will be discussed in more detail in chapter 4.3.4.

While equipment and financial constraints could be eased fairly quickly by simply allocating higher budgets, much more of a concern is the relative high level of reported insufficient competences of the human resources in the water sector in more than 20% of the cases. Upgrading or replacing staff is considerably more complicated and time consuming, assuming that sufficient competent staff is actually available on the labour market. If not, then these would need to be trained or in the worst case the whole education and training system would need an overhauling to produce the properly qualified graduates for the water sector.

Solving the shortages of staff (reported in almost 10% of the cases) could be a simple matter of increasing the budgets, but might also have to do with competition from the private sector, in which case higher remuneration should be considered. It becomes even more complicated when properly qualified staff is not available on the market.

Gaps and Overlaps

After assembling all the information from the actors' survey the results indicate that for the following functions no actor had been identified:

1. Water Management functions:
    - Approve operation and maintenance of water infrastructure
    - Licencing the disposal of waste water on the water system
    - Licencing the disposal of waste on the water system
    - Licencing the disposal of heat on the water system
    - Licencing construction within the water system
    - Collection of taxes/fees/levies/charges for disposal of waste/waste water/heat on the water system
    - Water-related health impact alleviation
2. Environmental Management functions:
    - Approve environmental norms and standards
    - Licencing waste disposal in eco-systems
    - Licensing game resource use, hunting and trapping

This does not necessarily mean that these functions are not carried out at all. It might be that the responsible organisation for that function is not listed in the surveyed group of actors – although the list of actors had been compiled with extreme care. This is probably the case with the function 'Licensing game resource use, hunting and trapping'. Functions regarding licencing and fee collection for waste disposal have meanwhile been covered with the promulgation of the Water Law (2012). This leaves no significant gaps in the implementation of functions for IWRM.

Although basically all necessary water, land and environmental management functions required for IWRM are being performed, that does not necessarily mean that these are implemented in the desired 'IWRM' way. This becomes obvious in particular when looking at the overlap of functions.

In the function dispersion matrices in Annex 5 more than one actor is listed for most of the functions. This does not necessarily indicate overlap since in most of these cases the various actors are performing these functions at different levels (e.g. national and local levels). Overlap found in any of the implementation functions is not very worrisome as it is a matter of taking some management decisions to correct the situation when it becomes an issue.

Of much greater concern are those functions that are performed by actors from more than one family of actors for example many of the monitoring functions show actors from all four families of actors engaged in monitoring. Already there is little coordination between actors within the same family, there is even less or rather none at all - between actors of different families. The questions that then arise are: what is done with these different monitoring data; who uses the data and what for; what is the quality of the data and the data processing; etc. All these data may be used and misused by whoever is pursuing some interest and the general public doesn't know whom or what to believe.

Also of great concern are functions that are performed by several actors of the same family and at the same administrative level for example many actors within the category of the central level public administration have been assigned coordination functions. The institutions which have a formal responsibility for coordination in water management are:

- the Government of Mongolia (i.e. the Cabinet)
- the Ministry of Nature, Environment and Tourism (now the Ministry of Environment and Green Development)
- the Water Authority (now absorbed in the MEGD's new Department for Coordination of Policy Implementation)
- the National Water Committee
- the Aimag and Soum Governors
- River Basin Committees

Despite the fact that so many actors are responsible for coordination, there is little indication in practice that such coordination is actually taking place. One reason may be the interpretation of the coordination task. In many cases the task of coordination does not go beyond calling all concerned parties to a meeting in which all are informed about a certain plan, policy or activity. Participants in the meeting often are not in a position to speak or decide on behalf of the organisation they represent and the meeting does not have the authority or mandate to take any decision and impose that on the participants' organisations. This reduces such coordination meetings to merely non-committal exchanges of information. Nevertheless, the sheer number of organisations that are assigned coordination tasks is an indication of the importance the Government attaches to coordination in water management.

A huge overlap exists on the functions under management of information in particular for professional use. Both government as well as non-government organisations are involved in that. The most important explanation for the large number of organisations involved in data collection and analysis is probably the lack of data exchange. The most frequent complaint ventilated during the surveys and interviews relate to problems with obtaining data from other parties. This results in huge amounts of work being repeated over and again by different organisations, wasting valuable resources and missing all the benefits of availing over complementary data.

These observations are in particular valid for water management and for environmental management. In land management functions (for as far as they have a bearing on water) this is much less an issue.

4.3.2. State disengagement

The state disengagement matrices for water management, land management and environmental management functions are presented in Annex 4. The matrices are in particular helpful in the analysis of the institutional setting in the context of two of the three the IWRM principles mentioned in Chapter 4.2:

- the principle of subsidiarity or decentralized versus centralized governance and
- the principle of stakeholder participation in decision making for water management

The state disengagement matrices present the outcomes of the actor survey in a way that allows for an analysis of which functions would need to be reassigned to other actors in order to fulfil the IWRM principles on decentralization and user participation. State disengagement matrices are included for all the identified functions in water management, land management and environmental management (for as far as the functions have a bearing on water). In the matrices the actor families are coded by colours (blue for the state, red for elected bodies, orange for civil society and green for IWRM bodies). The actor families are subdivided in categories, which in most cases divide the families in state and local levels.

On the vertical axis of the matrices all the functions in water management, land management and environmental management are listed. In the matrices the actors are listed for the functions they have been found to have a responsibility in the column of the category of actors they belong to. The actors are listed by their numerical code of which a legend is provided on the right side of the matrices. The colour of the actor code indicates whether the actor is performing the function regularly or on an *ad hoc* basis – in some cases this could not be ascertained and a grey colour is used. For actors who are only engaged in functions on an *ad hoc* basis it is more difficult to be held accountable and only in exceptional cases should responsibility for functions be assigned to actors on an *ad hoc* basis.

With regard to decentralization and subsidiarity the first observation that can easily be seen in the matrices is that by far most of the decision-making functions are assigned to actors at the state level. Actors at the local levels are mainly involved in implementation of decisions.

An indication for user involvement would be the degree user representative organisations are involved in decision-making. Organisations representing user interests are the national and local NGOs. From the matrices it can be concluded that NGOs are only sporadically involved in any of the functions and when they are it is on an *ad hoc* basis. Although there are a few functions on user consultation, but being consulted as a user can hardly be considered ‘user involvement’, because what will be done with suggestions from users is still a unilateral decision of the consulting agency, who isn't even obliged to inform the users what is done with their suggestions.

Besides NGOs, River Basin Councils provide another platform for user participation. According to the Water Law (2004) the River Basin Councils are to participate in organizing protection and afforestation activities of water sources supported or initiated by citizens' or professional organizations. The new Water Law (2012) is even more specific in defining as the main task of the River Basin Councils: "... to engage citizens in local water management for protection, effective use and restoration of water resources." However, the first River Basin Councils that have been established are dominated by representative from the public administration and line ministry agencies. Civil society organisations and NGOs only have a token representation in the Councils. Again user participation is limited to being consulted at the discretion of the Councils, who in turn again are not accountable for what they have done with users' suggestions. The users are only left with the option to agitate against decisions. NGOs often are the driving forces for mobilizing public displeasure with the measures and decisions taken by the authorities.

Decentralisation and user participation by 2015 and 2021

A panel of institutional experts made recommendations with regard to which functions should be the responsibility of which family of actors (state, elected bodies, civil society or IWRM bodies) in IWRM. This would imply that a considerable number of functions would be transferred from the actors who are currently responsible to other actors. Transferring functions cannot be done overnight and it is important to plan the timing and sequence of such transfers of functions right.

In the State Disengagement matrices presented in Annex 4 show which of the actor families or categories would ultimately become responsible for each of the functions for effective IWRM. Allowing for a stepwise completion of the transfer of responsibilities the matrices show the desired situation in 2015 (intermediate phase) and 2021 (end phase).

These matrices are in particular useful to decide the functions that need to be transferred to the River Basin Organisations. The distribution of functions among the families of actors is based on the in the IWRM principles and can be summarized as in Table 12.

Table 12. Function allocation to actor families by 2021

Actor Family	Type of functions to be assigned in IWRM
Elected bodies	• Policy decision taking • Approving and allocating budgets • Promulgating laws • Defining taxes, fees, levies and charges
State	• National development planning and budgeting • International coordination • Preparation of laws. regulations, standards and norms • Risk assessment, prevention and impact alleviation
IWRM bodies	• Management, and coordination • Inspection and enforcement • Assessment and monitoring • Planning and public consultation • Licencing and collection of fees, levies and charges • Information management and information dissemination
Civil society	• Implementation functions (construction, operation, maintenance) • Monitoring • Public awareness

It should be realized that the introduction of River Basins does not mean that all kind of new functions will come into existence. On the contrary, all the functions to be carried out by the RBOs are currently already carried out but by existing organisations. That means these functions have to be transferred. Transfer of functions always involves at least two actors. One actor that will be newly assigned a particular function and the other actor that will need to be relieved of that function. Transferring a function to an actor (and providing all the required facilities for it) is complicated, but relatively simple in comparison to relieving the other actor from that function. That usually is met with lots of objections, resistance against and sometimes active sabotage of the transfer process.

4.3.3. Cross-sectoral integration or 'coordinated management'

Assessing the IWRM principle of cross-sectoral integration is quite complex as it cannot be measured in a straightforward manner and the term 'cross-sectoral integration' itself is subject to a wide range of interpretations. This makes an assessment quite a subjective exercise and leaves the result open to discussion and endless arguments. Nevertheless cross-sectoral integration is generally considered as the cornerstone of IWRM (see Figure 16 on page 37) and does require an analysis.

Quite a number of the functions defined for IWRM have to do with coordination and from the MIMAT output (Appendices 5 and 6) it can be seen that a considerable number of actors do or are supposed to have coordination tasks, notably the National Water Committee, the Water Authority, the MNET and the River Basin Committees, but also the Ministry of Finance, and the Governors and the Citizens' Representative Khurals at the local levels.

Across the board, coordination is not effective at all. The main reason appears to be that those given the responsibility to coordinate do not have authority over those they are expected to coordinate. From series of interviews with key actors it emerged that 'coordination' is for most of these actors limited to merely exchanging information. A typical example is the functioning of the NWC, pre-eminently a coordination body. Members of the NWC include the highest officials of all relevant ministries, but decisions or resolutions of the NWC are not binding to any of these ministries. Coordination is thus limited to exchanging information and opinions. The National Water Program prepared by the NWC indeed has included all kinds of measures proposed by all the relevant ministries and compiled in a single document this is presented as the result of coordination.

In practice neither the MNET nor the WA is in a position to have a decisive say in any of the water or environment related policies or programs of other ministries. This reduces their coordination functions to only facilitating the exchange of information, without any control over the outcome.

River Basin Committees are still too few and too young and immature to take on the responsibility of coordination, besides the fact that their mandate is lacking in providing them with the authority to have any kind of control over activities by line ministries in their Basin.

Many interviewees assumed that the Ministry of Finance is in a position to coordinate as it controls the financial flows for projects and activities. However, it should be appreciated that the Ministry of Finance lacks all the technical capabilities and understanding to make the necessary educated judgements for effective coordination.

Possibly only the Governors are in a position to actually coordinate activities; they are in a position above the technical departments in their jurisdiction and can actually coordinate the activities of these departments. However, the jurisdiction of Governors is limited to their own aimag or soum only and they again appear totally ineffective in coordinating activities by state level organizations within their jurisdiction.

The weakness in coordination is becoming painfully clear when it comes down to the coordinated use of data and information. This could be considered the very starting point of coordination. However to obtain data from other sources than your own organisation requires a major effort in Mongolia and in many proves virtually impossible. Data are collected by more than a dozen organizations, most of which specialize in a specific field. From there on these data are treated as assets owned by that particular institution. Third parties trying to obtain existing data (e.g. for planning purposes) should be prepared for an uphill battle, even for organizations within the same ministry. As a result plans are often prepared with sub-optimal data sets and there is a lot of duplication in data collection, which is an unacceptable waste of public funds.

Although cross-sectoral integration or coordinated management is considered the keystone for IWRM, in Mongolia it appears to be by far the weakest and least developed of the three basic principles of IWRM.

4.3.4. Financing the IWRM institutions

Proper functioning of water management organizations depends amongst others on adequate financial resources. The financing of the Water Authority is taken as an example of the financing of water management institutions.

The 'Law on Re-Investment of Natural Resource Use Fees for the Protection of the Environment and the Restoration of Natural Resources (2000)' specifies that some 35% of the collected water use fees are to be used for water protection and water management. In addition, as it is stated in the same Law, a similar amount should be allocated for the same purpose from the State Budget. The money which thus becomes available should in principle be allocated to IWRM activities. However, this clause of the Law is not enforced. The reasons forwarded are that most of the water use fees are collected by the aimag and soum Administrations. As these are in many cases about the only sources of income besides the allocations form the state Budget for aimags and soums, there are many higher priorities that are served first before any financing for water protection or water management is considered. Moreover, the operational costs of the government organisations are paid for from the State Budget.

In principle the financing for water management organizations in Mongolia could be drawn from the following sources:

- State (or local government) budget
  At national level, the NWC and the WA were financed from the State budget through the annual budget allocation of MNET. It has not been possible to establish the precise amounts that are made available annually from the State Budget for the NWC and the WA.
  The State Budget is presently under pressure due to the world economic crisis.
- Water related fees
  The water related fees are subject to the Law on Fees for the Use of Water and Mineral Water (1995). In spite of what is stated in the Law on Re-Investment of Natural Resource Use Fees for the Protection of the Environment and the Restoration of Natural Resources (2000) water fees are collected by the Tax Offices at the soums and aimags and none is used directly for funding of the Water Management Organizations. Tax Offices are required to report on collected water fees. Access to such reports has not been granted and the actual amounts collected as water fees could not be established.
- Direct payment of services.

The Water Authority generated some of her funding directly through payment for services related to licensing and possibly other services. Details of this source of income are presented in Table 13..

On the basis of information provided by the Water Authority the historic development of the organisation's annual budget could be compiled (see Table 13). This table does not include the income and expenses related to foreign-assisted projects like the IWRM project and the UNDP project.

It is clear that the funding from the State Budget has increased significantly since establishment in 2005 as have the total expenses. Nevertheless the operational budget is still very small by any standard and remains largely insufficient.

Table 13. Budgets and expenditures of the Water Authority since its establishment

Year	Funding from State Budget ₮ million	Income from licensing ₮ million	Other income ₮ million	Total income ₮ million	Total Expenditures ₮ million	Balance ₮ million
	a	b	c	d=a+b+c	e	f=d-e
2005	56.3	24.5		80.8	74.7	6.1
2006	71.8	20.1		91.9	93.1	-1.2
2007	95.5	15.7		111.2	103.3	7.9
2008	137.1	33.1		170.2	164.2	6.0
2009	212.1	5.6		212.1	222.5	1.3
2010	200.1	50.0	395.0 *	595.1	224.9 + 395.0	25.2
2011	267.7	85.0		352.7	244.8	107.9
2012	636.9	41.0**		677.9	424.0**	253.9

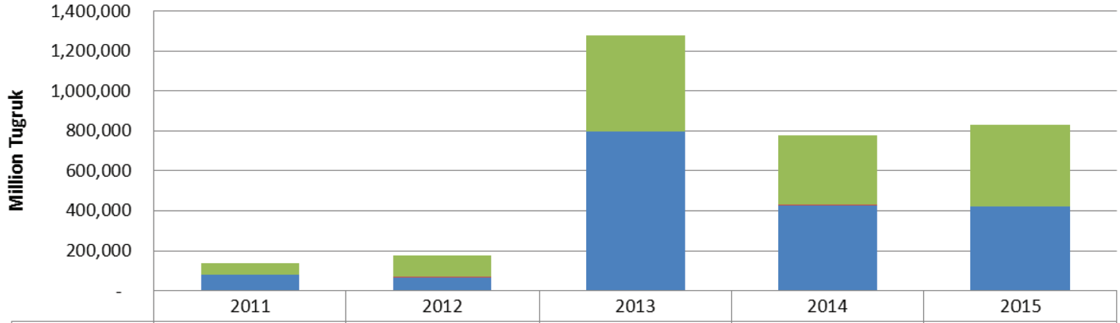
* *extra for establishment of water laboratory*

** *amounts till 31-08-2012 only (WA was disbanded as per 28 August 2012)*

Info provided by Admin & Fin department of the Water Authority

The annual budget of the WA is very small, specifically so when compared with the planned expenditures under the National Water Programme (see figure 5). Of course the WA is not the sole institute involved in water management and therefore its budget does not represent the full cost of water management in Mongolia. However it does indicate that the budgets available for water management activities is small when compared with the implementation funds.

The budgets for the implementation of the measures as identified under the National Water Programme, 2011-2015 are listed in Figure 18. The operational budget of the main coordination organisation for water management, the Water Authority, amounted to MNT 353million in 2011 or just 0.25% of the (relative small) investment budget for 2011 of MNT 138,230million. Even when the WA's budget would increase tenfold over the coming years would still leave the cost for the coordination organisation at a mere 0.4% of the planned annual investments after 2012.



	2011	2012	2013	2014	2015
Foreign Aid	57,212	108,971	480,300	345,215	408,025
Private Sector	1,806	1,482	3,017	3,581	3,844
State Budget	79,212	66,701	796,172	426,754	419,832

Figure 18. Investment plan for the National Water Program - phase I

5. Conclusions and recommendations

5.1. Priorities for IWRM

5.1.1. General

This report presents an institutional analysis of the water sector with the objective to draw conclusions and recommendations for institutional measures to improve integrated water resources management in Mongolia. In the foregoing chapters the institutional landscape has been described and analysed in the context of IWRM.

IWRM itself is an ever on-going process of improvements. So when introducing IWRM the question arises where to start with. Most probably one would wish to start with measures that are cheap and quick to implement and have the most effect. Although there is no standard recipe for introducing IWRM, there surely is some logical sequence for necessary measures to be implemented.

In the following chapters we will explore which are the most fundamental issues that need to be solved to lay a solid foundation for IWRM in Mongolia starting with a brief description of the fundamentals of IWRM.

5.1.2. Integrated Water Resources Management

In general the problems we are trying to resolve in water policy focus on finding satisfactory ways to balance the allocation of scarce resources to the diverse and competing objectives of society and environment. This need for balancing has brought us the concept of 'integrated water (resources) management (IWRM)', which in essence means: to combine - and when necessary compromise - between actions and objectives preferred by different players to achieve the best overall result. This 'combining and compromising' is what converts '(ordinary) management' to 'integrated management'. Several definitions have been formulated for IWRM, but the one most commonly used and widely accepted is the definition formulated by the Global Water Partnership that reads:

> *IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.*

The basic principle of integrated water resources management is that the supply is renewable, but limited, and should be managed on a sustainable use basis. At the heart of IWRM are the four well known Dublin Principles. However, IWRM is not a recipe, a model, or a standardized step by step approach. It is more like a philosophy for improving water management in the context of a continuous increasing water demand in a world of ever decreasing water availability. The Dublin Principles provide the framework for applying this philosophy. The questions like: how to implement or introduce IWRM, where to start, at what pace and who should be involved, do not have straight answers and depend on the time, the location, the specific institutional situation, local history and culture, etc. Even at one particular place at a specific time there are still many ways to go about IWRM; some would probably have a preference of one particular action over another, but none is wrong as long as the actions comply with the philosophy of IWRM.

The common frame work for IWRM is that, while taking into consideration local and regional variations, integrated water resources management

- encourages planning and management on the basis of natural water systems through a process that is dynamic and adapts to changing conditions
- balances competing uses of water through efficient allocation that takes into account social values, cost effectiveness, and environmental benefits and costs
- requires the participation of all units of government and stakeholders in decision-making through a process of coordination and conflict resolution
- promotes water conservation, reuse, source protection, and supply development to enhance water quality and quantity; and
- fosters public health, safety, and community good will

Figure 19. IWRM: balancing competing objectives

Any action or activity within the frame of the above five features of IWRM constitutes a contribution to furthering IWRM and can, in principle, never be wrong; the only possible mistake is to do nothing! Nevertheless, some actions or activities are likely to be more effective and efficient than others and a proper analysis of the current situation may yield the priority actions at a given moment in time. As IWRM is a philosophy – a way of thinking, or even more specific, an approach to water management, IWRM is never finished, completed or achieved; there are always next steps to be taken for further enhancement.

What leaps out from both the GWP's definition for IWRM and its five features mentioned above is the term '*coordination*'. While most of the text in the definition and the features rather describe goals or objectives, the word 'coordination' provides us with a specific prescription on how these goals and objectives would be achieved. Besides, according to the Collins English Dictionary, the term 'integrated' as in 'integrated water management' means: '*organized or structured so that constituent units function cooperatively*'. The word 'cooperatively' again implies coordination. This further amplifies the very close relation between the concepts of integration and coordination. A closer look at this relation in the specific context of water resources management is called for.

5.1.3. Coordination in integrated water management

Basically the term 'to coordinate' means 'to harmonize'. The formal definition of coordination is: '*the orderly arrangement of individual and group efforts to provide unity of action in the pursuit of a common goal*'. More specifically in the context of water resources management, coordination involves harmonization of different activities and efforts by the various actors in the sector in a way that the planned objectives may be achieved with minimum conflict. However, coordination is not as clear-cut as the above may suggest, because as society – or in our case: water management - becomes more complex, the concept of coordination also grows in complexity.

Also integration is not such a straightforward concept. Integration in water management has many dimensions. Mitchell (1990), for example, wrote that integration deals with: "*... problems that cut across elements of the hydrological cycle, that transcend the boundaries among water, land and environment, and that interrelate water with broader policy questions associated with regional economic development and environmental management*". To come at grips with these many dimensions of integration in water management it is helpful to distinguish several integration categories. These categories can in turn be linked to various types of coordination that each can be derived from the features of IWRM described above. A summary overview is given in Table 14. A more detailed overview is presented in Annex 9.

Table 14. Integration categories and their relation to types of coordination

Integration category	Type of coordination
Political integration	Stakeholder coordination
	Intra-governmental coordination
Political integration / Geographic integration	Coordination between local and regional concerns
Geographic integration / Hydro-ecological integration	Coordination between watersheds and natural water systems
Hydro-ecological integration	Coordination between water quality and water quantity
Integration of purpose and functions	Coordination of competing uses
Integration of various disciplines	Coordination between society and environment
	Coordination of the means of water management
Integration of data and information	Coordination of activities over time

The obstacles to integrated water resources management are primarily those that constrain success in the (types of) coordination shown in Table 14. Hence **coordination appears to be the core of integrated water resources management**.

5.1.4. Coordination

Coordination ensures unity of action among individuals, work groups and departments, and brings harmony in the implementation of the various activities and functions so as to achieve the organisation's goals efficiently. However, we already observed before that when society – or in our case: water management - becomes more complex, coordination also grows in complexity. Two approaches for coordination may be distinguished:

1. coordination through consensus
2. coordination through authority

Coordination by consensus is more likely to bring about broad support and commitment for the opted approaches, which is of great value and definitely will ease implementation. However, there also are considerable disadvantages, such as the time required to reach consensus, which makes this approach not very suitable in matters of urgency. The end result of consensus would be a compromise that has something in it for everybody, which at the same time means that everybody had to surrender something also and nobody gets completely satisfied (as they say in Mongolia: "when compromising, everybody loses"). To satisfactorily achieve coordination through consensus is not always possible and requires a number of favourable conditions that include:

- negotiators all aim at common goals

- issues are not very complex
- absence of power relations among the negotiators
- ideally, negotiators have interdependencies

Figure 20. Common goals and interdependencies

Except at a small scale, e.g. in user groups, these conditions are unlikely to be met in water management. That then leaves us only with the option for coordination through authority. This authority could be based on virtue, e.g. respect, seniority, superior knowledge or it could be hierarchal, which means that the coordination is imposed by a higher level authority. Authority based on virtue is desirable, but depends solely on the individual person and is therefore nor suitable to be institutionalised. Systems of hierarchal authority have been used in most centralised water management systems and have been fairly successful for a long time. It is the standard system in the central planned economies of communist states and has been quite successful there as the level of respect for authority is very high, probably because disobedience carries extremely severe repercussions.

Coordination by authority results in faster decision-making and a less distorted aggregation of information, which is good, but it comes at a price. The final decisions tend to be strongly biased towards the ideas of the controlling authority. Authoritative coordination is preferred and generally accepted for problems which are very urgent or extremely complex. However, when the urgency of the decision is not widely shared, the imposed coordination faces a major obstacle in the lack of commitment among the actors. Actors have difficulties identifying with the decision biased towards the controlling authority's ideas and try to evade compliance whenever they can and often are found to spend much effort, energy and resources on circumventing the imposed decision.

In many, if not most, modern societies, respect for hierarchal authority is fading and, strong top-down management approaches are quickly labelled 'un-democratic'. This weakens hierarchal authority and objectives are seldom achieved, because, despite the imposed common goal, competition between actors is allowed to subsist. For the actors there are no incentives to surrender their own ambition in favour of a 'common' goal that is imposed on them and when even the 'common' goal is achieved, these actors are unlikely to be credited for it. Hence, in reaction the actors divert their best resources as much as they can to pursue their own priorities. In turn, the authority tends to dedicate considerable resources to ensure that actors remain on course and within the approach as set out. In doing so the authority introduces ever increasing control, reporting, and monitoring procedures. The end result is a highly bureaucratized system - based on distrust - that seems to be more dedicated to bureaucratic procedures than to the actual objective like water management. The end result is an exceedingly inefficient system that is very costly, but producing very little in terms of actual results. In times of increasing scarcity of resources (including water, financial and human resources) the call for change becomes louder and louder.

IWRM is a result of such calls for change. Closing the circle, IWRM has 'coordination' again at its core and requires cooperation as well. Cooperation can only be successful when the co-operators are committed to the same goal. But, we have just seen that commitment can only be achieved through 'coordination by consensus', which in turn is unlikely to succeed for complex issues such as modern day water management. The big question now is: Is there a way out of this vicious circle? The solution has to be found in taking the best from each form of coordination. This takes shape in establishing a platform where all the actors participate in the **decision-making**, but where the actual **decision-taking** is not necessarily on the basis of consensus – a form of majority decision-taking may be decided on. This in itself is not enough however. The most important and vital conditions are:

- all decisions taken by this platform are authoritative and binding to all actors,
- the decisions taken by this platform are supported by an authority that is superior to all the actors and which will hold the actors accountable for their task in implementing the decisions

5.1.5. Summarizing and conclusions

By analysing the coordination processes it appears that improving coordination is the most promising route to the concept of integrated water management. The central questions are how to make coordination work and how can mechanisms for coordination be made more effective?

Looking at coordination as a process, two basic approaches were discussed that each seem to be quite limited in their applicability and not very suitable for dealing with the modern day complex water management issues. Still maintaining that coordination is the core of IWRM requires a careful design of the coordination process that avoids the weaknesses of the two basic forms of coordination that were discussed. The answer is a blend of both forms consisting of platforms of actors and/or stakeholders where decision making takes place, but where the decisions taken are backed by an authority that is superior to all of the actors'. Often such decision-making and decision-taking structures are not in place when introducing IWRM and need to be set up. In the concept of IWRM this is referred to as the 'enabling environment', 'institutional roles' and 'management instruments' that are needed for the necessary 'cross-sector integration'. **Establishment of effective coordination bodies is by far the most crucial element for successful introduction of IWRM.**

The features describing integrated water resources management were used as a framework to derive types of coordination. The formulation of the features may not be perfect or scientific, but it represents a good description of what water management experts in general considered to be the overall management problem. Analysing these features led to the identification of nine types of coordination. The types are not unique, of course, but they enable us to break down the very complex concept of integrated water management into smaller, manageable chunks and allow us to focus on areas where intervention is likely to be the most effective, rather than having to address the whole complex spectrum of coordination all at once.

In Mongolia the most critical type of coordination to be addressed at this moment is intra-governmental coordination. Almost all the main actors in water management are government organisations that at present enjoy a high degree of independence with respect to their role in water management. Although the MNET, the NWC and the Water Authority are each charged with coordinating roles in water management, they all lack the necessary authority to be in any way effective to coordinate the other actors or their activities.

The second most critical type of coordination would be the stakeholder coordination through the River Basin Councils. Again the River Basin Councils as coordinating platform lack the authority to impose any of its decisions on the main actors in water management. As the first RBOs have recently been established and many more are planned for, it is important to quickly establish their authority or otherwise the whole concept of RBOs will become a very frustrating and disappointing exercise. To overcome such a negative initial experience will turn out to be very costly in future and will continue to feed opposition to the concept for a very long time.

Without success in establishing effective intra-governmental and stakeholder coordination it is an illusion to expect any positive results regarding geographic and hydro-ecological integration.

A critical form of integration that affects all other categories of integration is data and information integration and should be high on any priority list. Coordination between competing uses is only a high priority at specific locations such as Ulaanbaatar and a few other population centres and the south Gobi area with very limited water resources.

To conclude, the introduction of IWRM in Mongolia should initially focus on establishing effective intra-governmental and stakeholder coordination that is backed by authority. A crucial contributor to success is integration of data and information, without which all other forms of coordination will be severely hampered. For the time being the urgency for coordination of competing uses is limited to a few specific locations only, notably Ulaanbaatar and a few mining sites in the South Gobi region.

Table 15. Priorities to focus on integration categories and types of coordination

Integration category	Type of coordination	Priority
Political integration	Stakeholder coordination	high
	Intra-governmental coordination	very high
	Coordination between local and regional concerns	low
Geographic integration		low
	Coordination between watersheds and natural water systems	low
Hydro-ecological integration		medium
	Coordination between water quality and water quantity	medium
Integration of purpose and functions	Coordination of competing uses	localized
Integration of various disciplines	Coordination between society and environment	low
	Coordination of the means of water management	low
Integration of data and information	Coordination of activities over time	high

These most crucial forms of coordination very much cover the decision-taking processes and once in place and functioning satisfactorily the remaining types of coordination can be expected to follow and develop quite naturally, because these are the types of coordination that deal mainly with implementation and operation, which is subordinate to the decision-taking processes (see Table 15).

5.2. Institutional measures

Measures are required to address the issues identified in the previous chapters. When considering the introduction of IWRM as a prime objective, the most important issue to be addressed would be the ineffectiveness of coordination in the water sector. Necessary measures to address this issue are measures with regard to institutions for IWRM, which would be new organisations or new mandates for existing organisations that need to be set up. The institutional measures proposed here have been designed as much as possible as a further evolution of the current institutional framework. Therefore the proposed measures avoid drastic overhauls of the current situation, but adhere as much as possible to the existing organisational structures and minimize the need for legal amendments.

A restructuring of organisations in the water sector would require legal amendments. However even without that the existing laws and regulations suffer from inconsistencies and even contradictions that need cleaning up. Certain issues in water management are not taken care of by the existing legislation at all, such as dispute resolution, and need to be included. A major concern that urgently needs to be addressed is the problem of enforcement of laws.

Insufficient financial and material means are at present a major constraint for effective execution of water management functions in about a quarter of the cases surveyed. Besides f financing the implementation of water management measures, the recurrent costs for the water management organisations and institutions need to be covered in a reliable manner. Failing to provide these organisations with the necessary means will lead to breakdowns in water management that will be many times more costly than the operating costs for these organisations. A more detailed assessment of the overlaps observed in the function implementation is likely to uncover options for cost saving.

Another constraint on water management uncovered by the actor survey was a considerably capacity issue. In almost 10% of the cases organisations did not avail over enough staff to satisfactorily implement their required water management function and in almost 20% of the cases the staff was not adequately qualified for their job. This points to a problem with capacity building for water management, but may partly be linked to the tight budgets organisations are suffering from.

Monitoring, research, data collection and information management is highly dispersed and poorly managed in the water sector. This leads to a lot of duplication, competition and contradictions. Although it is difficult to quantify the existing situation is probably causing a considerable waste of valuable human and financial resources. Measures need to be taken for major improvements in the coordination and control of monitoring, data collection and information management. Research would benefit from improved coordination as well.

Restructuring of the public sector, legislation and financing is not enough to bring about the required improvements in the water sector. Ultimately every single individual is a stakeholder in water management and with their behaviour affect the water management system. Therefore every individual does have a responsibility towards water management. However it cannot be assumed that every individual is aware of his/her responsibility and the consequences of the actions. The public needs to be informed about their responsibility and how their behaviour affects water management. By making the public aware their participation can be solicited to benefit water management.

5.2.1. Organisations

At the national and the regional (river basin) levels parallel apex IWRM organisations need to be established for decision-making and decision–taking; It is proposed to achieve this through the establishment of water councils At the national level this would be a National Water Council, at the regional level this would be the River Basin Councils (see also Figure 21).

For the National Water Council and the River Basin Council to take well informed decisions, they should not only have to rely on the information contributed by their members (the actors and stakeholders) as their contributions are likely to be biased towards their own interests. The councils need their own independent technical advisers with adequate resources to make independent assessments of the issues being discussed. Hence the Councils require their own technical offices, manned with professional staff and adequate means. At the national level that would be a National Water Authority and at the regional level that would be River Basin Authorities.

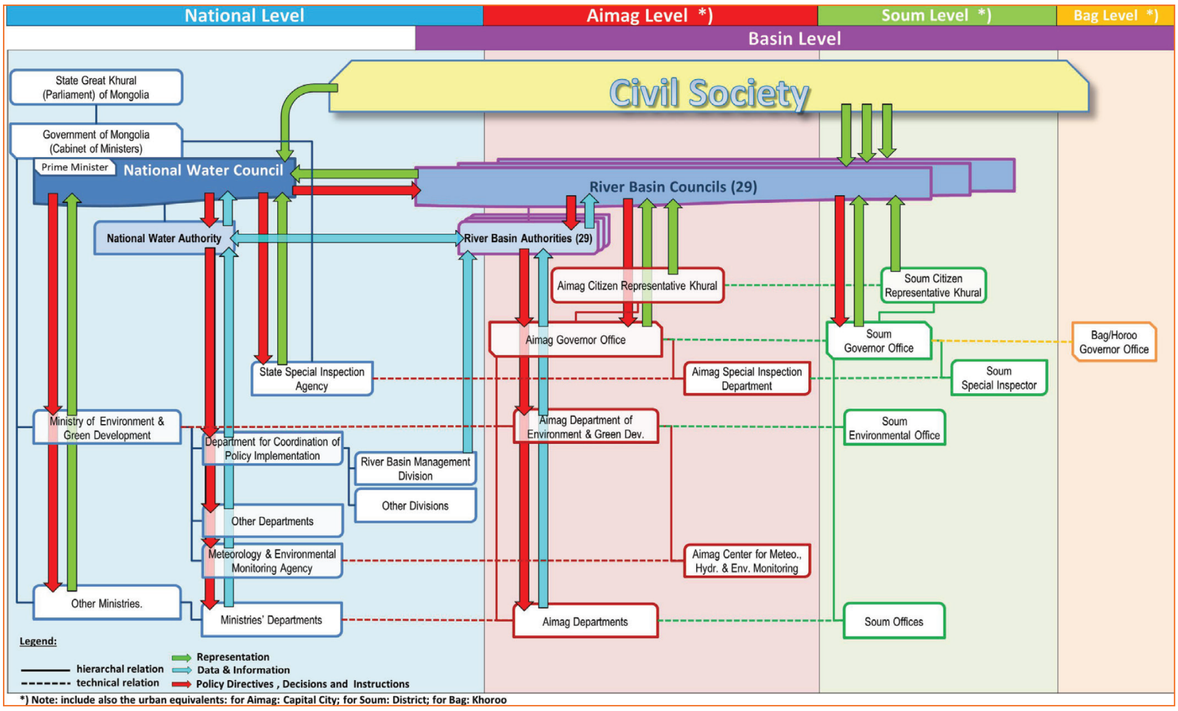


Figure 21. Proposed institutional structure for the water sector in the context of IWRM

Membership

All relevant actors and stakeholders need to be involved in the decision-making, which should be reflected in the membership of the councils. The proposed membership of the councils is shown as green arrows in the diagram of Figure 21. At the national level the National Water Council membership would include senior representatives of the relevant line ministries, e.g. the State Secretaries, but also representatives from the civil society, possibly through representatives of relevant NGOs and civil society organisations. It is important to ensure that all the members of such a National Water Council actually do represent the opinions of the organisation or group they represent (and do not speak in the council in a personal capacity) and that they are accountable to those they represent.

At the regional level the local administrations, representatives of the local offices of the relevant line ministries would be members of the River Basin Councils as would representatives from the civil society, probably through representatives of relevant NGOs and civil society organisations. Also at the regional level it is important to ensure that each of the members of the River Basin Councils actually does represent the opinions of the organisation or group they represent and is answerable to those represented.

At the national level the River Basin Councils are to be seen as stakeholders and therefore need a representation in the National Water Council.

Mandates and responsibilities

All decisions regarding water management would be taken by the councils; at the national level by the National Water Council and at the regional level by the River Basin Councils. The decisions taken by the councils at the national and the regional levels are binding to all actors and stakeholders at the respective levels (see the red arrows in the diagram of Figure 21). Since the River Basin Councils are stakeholders at the national level also the River Basin Councils are bound by the decisions taken by the National

Water Council. Hence the River Basin Councils operate within frameworks established by the National Water Council.

Internally in the councils, decisions are made with the participation of all members of the council. In preparation of the decision making all relevant data and information is requested by the National Water Authority and the River basin Authorities respectively from the relevant agencies and institutions, who should legally be required to unconditionally provide such data and information. After analysis the National Water Authority and at the regional level the River Basin Authorities prepare an unbiased advice for the National Water Council and the River Basin Councils respectively prior to the meeting at which the issue is to be discussed. The National Water Authority and the River Basin Authorities are obliged to keep each other informed at all times and each has to make sure the other is constantly updated with the latest information and data. In Figure 21 the blue arrows represent the information flows.

However, the membership of the council is not composed of entirely equals; some members have much more (technical) knowledge and understanding of the issues being discussed than others, while some represent much more powerful or financial independent organisations than others. Realistically it cannot be expected that the membership of the council has one common goal. Naturally the members are more inclined to defend the interests of the organisation or group they represent and therefor it is an illusion to expect that the council will easily reach consensus decisions. To maintain the efficient operation of the council the process of decision-taking needs to be in the control of the chairperson of the council, who for that reason needs to be of senior authority and not having a direct stake in the issues discussed.

Structure

Council decisions are binding to all actors and stakeholders, which would be achieved through an endorsement of the councils' decisions by an authority higher than the actors. At the national level the National Water Council would therefore be chaired by the Prime Minister and with a further structure very much in line with the latest restructuring of the National Water Committee, but with more authority over the line ministries (the chief actors in water management at the moment).

At the regional level the River Basin Councils would form the apex IWRM body for the coordination of water management, but their present mandates would need much further enhancement to give the decisions taken at the Councils much more authority. This could be achieved by a rotating chairmanship among the respective aimag governors, or a joint chairmanship by a college of respective governors, or by creating a new position of River Basin Governor, appointed by the Government similar to the appointment of the aimag governors, but who has a mandate superior to that of the aimag governors.

As opposed to the latest government restructuring in this proposal the River Basin Authorities would be subordinate to the respective River Basin Councils instead of the River Basin Councils being subordinate to the River Basin Authorities. The changeover would be a matter of timing, as at present the River Basin Councils are still too immature and inexperienced too take on the superior position. The present (August 2012) institutional structure should thus be considered a transition phase with the aim to strengthen the River Basin Councils to a level that they take on their more authoritative role as soon as possible.

Other organizations

Once the IWRM's coordinating bodies (National Water Council and River Basin Councils) with their supporting authorities have been institutionally embedded, the mandates and responsibilities of all other actors in water management need to be adapted to this new hierarchy of decision-making. The amendments will quite naturally flow from the newly established situation as depicted in Figure 21.

A separate issue is the lack of specific technical water and environmental management knowhow at the State Special Inspection Agency that hinders efficient and effective enforcement. Cooperation between the State Special Inspection Department staff at the local levels and the technical staff of the various water and environment related departments at the local levels needs to be much improved and formalized to become much more effective and efficient.

Within the context of IWRM a phased transfer of tasks and responsibilities from public sector organisations and agencies to the private sector and NGOs is foreseen (refer to chapter 4.3.2). These new tasks and responsibilities need to be formalized, while in parallel the public sector organisations that presently carry out these tasks need to be formally relieved from those responsibilities. This may include the transfer of specialised staff from the public sector to the private sector and NGOs.

5.2.2. Legislation

The existing legal framework on water management is fairly complete, although suffering from some inconsistencies, overlap and unclear and sometimes contradictory terminology. Arrangements regarding River Basin Organisations have improved in the Water Law (2012), but still a number of issues remain ambiguous and need to be further clarified. As River Basin Organisations further evolve and mature their mandates, tasks and responsibilities will increase and regular updating of the legislation will be needed over time. Another issue is the categorization of water users and water consumers that would require reconsideration.

There are two issues that already have been arranged by law for which implementation is still pending that need to be corrected urgently:

1. formalizing the pollution fees and initiating implementation
2. Transferring 35% of the collected water fees to water management budgets complemented by a similar amount from the state budget

Legislation needs to be updated to provide the IWRM coordination organisations (National Water Council with its associated National Water Authority and the River Basin Councils with their associated River Basin Authorities) the necessary mandates and authority as described in chapter 5.1.5 to effectively coordinate water management.

Legislation needs updating to facilitate the phased transfer of water management functions from public sector organisations to private sector, civil society organisation and NGOs. Adjustments may be required as well for further devolution of functions from the central government to the local governments and River Basin organisations.

5.2.3. Financing the IWRM institutions

With the proposed institutional development for water management, a significant budget increase is required to implement the tasks which are assigned to the organisations in an effective and efficient manner. New organisations like the National Water Council, the National Water Authority and the River Basin Organisations require an initial investment budget for their establishment and subsequently operation budget to cover their recurrent costs.

Water pricing and cost recovery offer options for increasing the financing for water management. However, besides generating funds, water pricing and cost recovery also have costs like the costs for metering and collecting the charges. Besides recovering costs, water pricing is often also applied to effect water savings for environmental sustainability. Water prices however, should be affordable for all layers of the public. These multiple objectives make water pricing and cost recovery a complicated matter.

Tariffs must be structured in a way that strikes an appropriate balance among these competing objectives. Many would argue that the two most important objectives are the financial sustainability of the service provider and the affordability of the service for low-income households. In the absence of balancing these two key objectives, the result is a vicious circle of under-financed services, lower-than-needed investment and maintenance and reduced access to water services. This will hurt the poor most as they are the first to suffer from low quality services. Prior to settling on a water pricing and cost recovery policy it is proposed to carefully study all the implications of various options for water pricing and cost recovery with regard to the multiple objectives for such a policy..

A detailed assessment of the overlaps observed in the function implementation may uncover options for cost saving.

5.2.4. Capacity building for water management

A shortage of manpower and lack of qualified staff is constraining water management. A study revealed that depending on the discipline between 15 and 50% of the graduates in water professions end up working outside the water sector. To avoid qualified staff to migrate to the more lucrative private sector the remuneration scheme, fringe benefits and career opportunities for public sector workers should be made much more competitive.

Water professionals looking for employment elsewhere only partly explains the shortage of qualified staff in the water sector. Another cause is the education system not delivering the required competences. Universities and education centres need to become more alert to the market needs and become flexible and responsive to evolving demands and quickly adopt their curricula accordingly.

It needs to be stressed that there is not only a need for highly educated professionals, but there may be even a greater need for qualified craftsman. Vocational education however has lost its appeal lately and attracts fewer and fewer students as university education is generally considered as the best starting point for a successful career. A change in mind-set is required to increase appreciation for non-academic skilled professions which obviously should be reflected in the remuneration, fringe benefits and career opportunities.

Worldwide water management is no longer the realm of hydrologists and engineers. Water management has become extremely broad multi-disciplinary field where many sciences and professions converge including economics, biology, sociology, engineering, hydrology, geology, etc. All these disciplines need to work together, which can only be successful when there is a certain degree of understanding of the disciplines other than your own, an appreciation for the contribution of other disciplines and respect for its practitioners. Unfortunately the education system in Mongolia is still quite single focussed and multidisciplinary courses are only now introduced like the BSc and MSc IWRM courses in which three universities cooperate. This development needs to be safe guarded and broadened.

5.2.5. Monitoring and research

Monitoring is highly dispersed and lacks a well-defined purpose. Data and information from monitoring only becomes useful and valuable when available as long time series. This means that initiating a monitoring program requires a long term commitment (and funding). At present financial resources for monitoring are used very inefficiently; a great many organisations and institutions engage in monitoring often for their own narrowly defined purposes. There is overlap due to poor communication and coordination or because data already available at other institutions cannot be accessed (see also chapter 5.2.6).

There is great need to rationalize the monitoring activities in the water sector for instance similar to the system for meteorological monitoring. A monitoring system also includes a quality control aspect, which is often underestimated, but actually of crucial importance. This is another reason why it should not be allowed that just anybody starts to monitor certain quantities and generation data without any quality assurance.

Research should respond to the needs in society and not just follow the private interests of the researcher. A close and formalized coordination between research institutes and universities on the one hand and the water sector on the other hand should lead to more applied research that responds to the needs of the water sector.

To enable the research institutes and universities to deliver their research capacity in the form of knowledge, tools and equipment need to be kept up to date. This means researchers need to update their knowledge through refresher courses; laboratories need to be equipped with the latest equipment and the latest computer hardware and software needs to be made available.

5.2.6. Data and information management

Data and information management in the water sector in Mongolia is a major issue. There are a great many institutions and organisations collecting or generating data without much coordination. There is no standardization for data bases and data bases are not linked. Standards and norms for data, data storage, data handling and quality assurance are lacking.

Moreover, data are in general inaccessible for third parties. Data are generally treated as assets and shared only against some form of compensation. Even when these data have been collected with public funding other public entities are not given free access to these data.

There is an urgent need for rationalization of data and information management in the water sector, with installing data quality assurance procedures, central databases for data storage, ensuring access to data for all with only some appropriate restrictions for data of a sensitive nature (e.g. state security). Hoarding of data and selling data should be made punishable by law, in particular when these data have been generated with public funding.

5.2.7. Public awareness and public participation

Public participation is an important element of IWRM. In Mongolia, as in many other countries, public participation is often limited to public consultation, without any accountability to the public.

Water management decision procedures need to be opened up for public participation. River Basin Councils and the National Water Council are platforms where public participation can be realized. NGOs and Civil Society Organisations are best suited to represent public opinion in such forums. Safeguards need to be put in place against these NGOs being hijacked by unscrupulous individuals using these NGOs to pursue their own interests.

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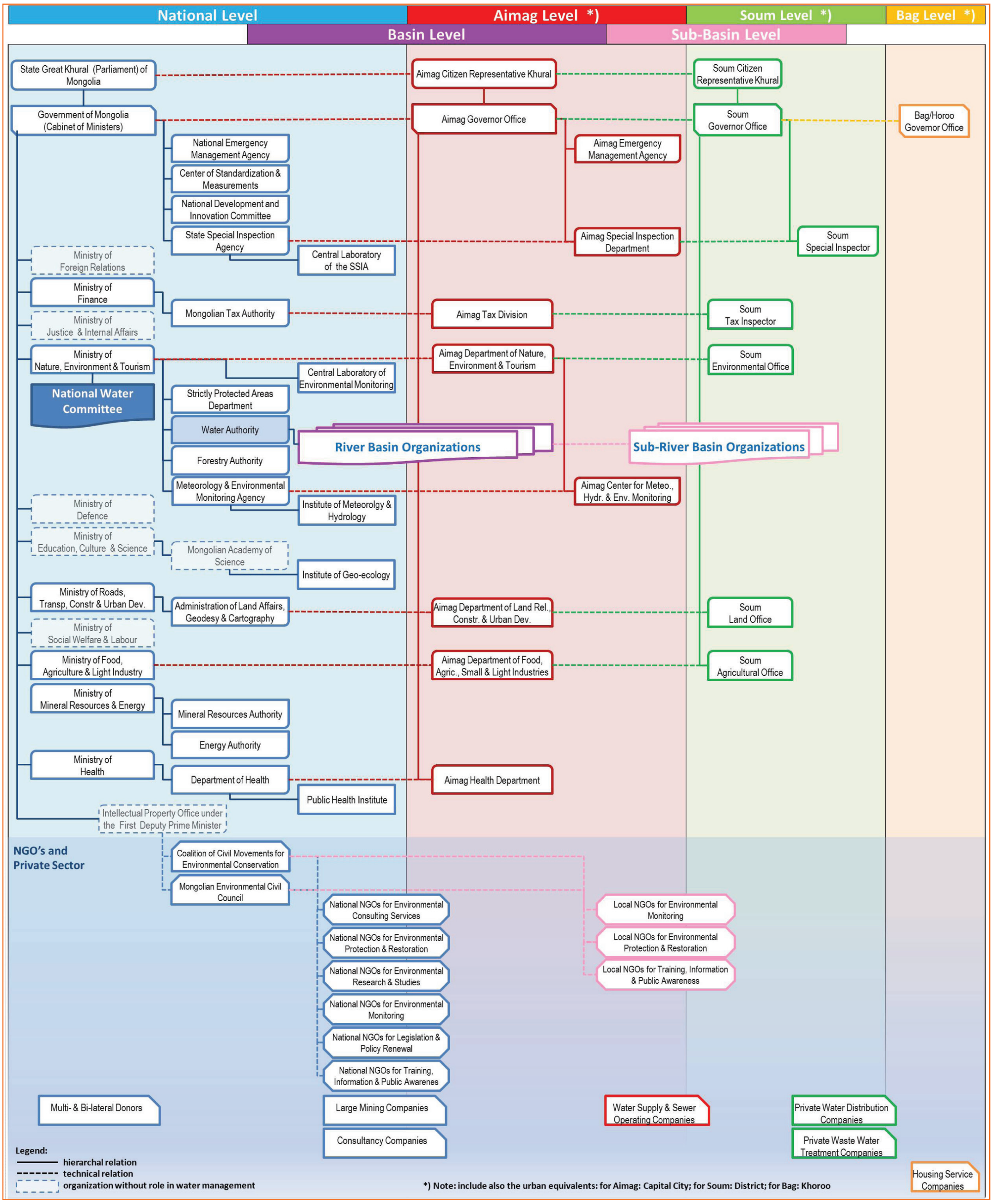
Annex 1: Institutional structure of the water sector (2010)



Annex 2: Description of MIMAT–software

The MIMAT software is a matrix-based tool to support a legal and institutional assessment in an IWRM framework

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Abstract

In the last decennia developing countries deliberately engage from fragmented water resources management towards Integrated Water Resources Management (IWRM) with support of the donor community. As part of the situation diagnostic, institutional and legal assessment of the water sector are usually required. For this purpose and in the framework of consultancy service commissioned by the Lake Chad Basin Commission (LCBC), a Matrix-based Institutional Mapping and Assessment Tool (MIMAT) was developed allowing a dissection and a first step analysis of the institutional landscape of water, land and environment management, highlighting the (potential) problem areas and bottlenecks for a coordinated cross-sectoral water, land and environment management. MIMAT visualises the relation between the management and the actors, rendering a structured pattern of the institutional landscape, establishing the links between the different actors and answering the question: "who is doing what, and how?" in the different sectors. Considering the local context, MIMAT allows an easier interpretation of the main IWRM principles. By virtue of its structured approach, the method offers a framework for an in-depth analysis of the institutions and legal framework governing the resources. It also allows the development of reforms towards an effective IWRM implementation, as well as the monitoring of the implementation process.

Introduction

Although IWRM has been loosely defined and interpreted in many different ways in the past, there now appears to be stronger agreement (GWP and van der Zaag, 2005) regarding the need for IWRM and what it should entail. More and more countries are willing to engage the IWRM process.

Royal Haskoning was requested to produce the legal and institutional assessment of the water sector in the five countries of the Lake Chad Basin, complete with legal and institutional reform proposals. For this purpose, a common methodology, as well as a basic database and first level assessment tool was developed. The latest version is described in this paper.

Aim and concept of MIMAT

The general aim of the Matrix-based Institutional Mapping and Assessment Tool (MIMAT) is to support the assessment of the legal and institutional aspects of integrated management of the water resources. Three following sub-objectives can be distinguished:

- The first sub-objective of MIMAT is to make the understanding of the institutional landscape easier. This objective is met through MIMAT's automatic capacity of mapping the institutions, answering the specific question: "who is doing what in a particular sector?"

- The second sub-objective is to make the identification of actions and reforms towards more integrated management easier. Based on expert assessment of the institutions, assessing their implementation level, MIMAT is able to visualise the bottlenecks in the water governance.
- The last sub-objective met by MIMAT, is the assessment of the IWRM action plan implementation itself.

As to achieve the above objectives, MIMAT needs a considerable amount of information and input related to institutions and actors contributing to the management of land, water and environment. The gathering and consideration of this large amount of data complicates the exercise of understanding the institutional landscape.

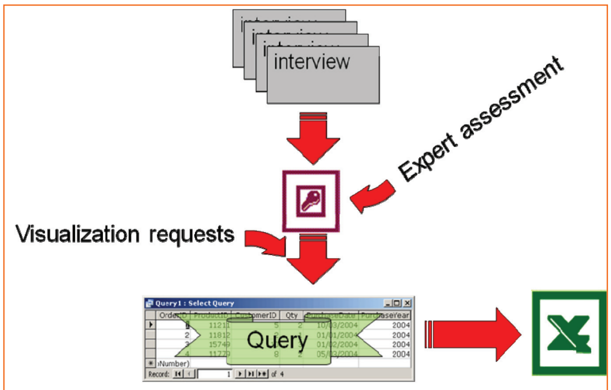

Fig. 1 : Structure of the tool.

As shown in figure 1, the backbone of MIMAT is an MS Access data base in which data obtained in interviews, documents and from other sources are stored. Some of the information stored requires an expert assessment. It is therefore important that the database be completed under the supervision of a legal or institutional expert / consultant.

Particular visualisation requirements format MS Access queries, which use MS Excel for the visualization. MS Access was chosen to allow flexibility and a friendly use to potential users with basic IT knowledge and experience.

Interviews

The interviews gather factual information of the institutions and actors in the field, such as:

- the category of actor and geographic scale of action,
- which managing functions is the actor supposed to implement according to its mandate,
- which managing functions is the actor actually implementing (de jure or de facto),
- with whom is the actor implementing the management functions,
- is the actor part of an consultative/participative IWRM-type of organisation, if yes, which one?
- what are the actor's human and financial resources.

The interviews are also requiring a certain institutional expertise in relation to the actor's implementation, to its mandate and its implementation means. An expert is therefore answering multiple choice questions such as:

- Is the actor properly implementing (his part of) the management function?
- Is the function properly implemented at the geographic scale of the actor, and in its entirety?
- How is the collaboration with the different partners in implementing the functions?

The use of multiple choice questions is considered as a first-level assessment, and allows a mathematical consideration for the visualization of the assessment.

Matrix-based visualisation

The main purpose of the visualisation is to produce understandable and clear graphical representation of the institutional landscape. The strength of MIMAT is that large amounts of stored information can be clearly visualised to answer particular questions a consultant should ask himself in order to draw its conclusions and propose reforms and actions.

The actors implementing water related management functions are defined in MIMAT by four main parameters:

- the category of actor type,
- the different management functions the actor is implementing,
- the geographical scale the actor is active, and
- the different land, water or environmental uses the actor is governing

In order to meet the various national and field specific conditions, the number and the label names of the four parameters are adjustable. This specific quality makes MIMAT to be flexible to fit any local context.

However, for the visualisation of this 4-dimensional concept we are limited to 2-dimensional printable matrixes, which implies that the tool has been developed in order to produce different matrixes considering particular 'visualisation requests' (see fig.1 above), where the X and Y axis are defined by the user depending on what he wants to see.

Discussion

According to the sub-objectives 1 and 2, the visualisation contains two aspects. The first is the institutional mapping. The second is the visualisation of the different first-level assessments. Depending on the user's requirements, MIMAT is able to produce maps in which the actors are set out relative to chosen parameters.

Institutional mapping

As referred to by the Technical Advisory Committee of the Global Water Partnership (GWP), considering the local context, IWRM of river and lake basins should be based on the implementation of some basic and general principles such as: (1) the principle of stakeholder participation in the decision making and in the management, (2) the principle of subsidiarity, (3) the principle of cross-sectoral management and upstream/ downstream dialogue, and (4) the principle of 'coordinated management'. In the framework of the institutional assessment

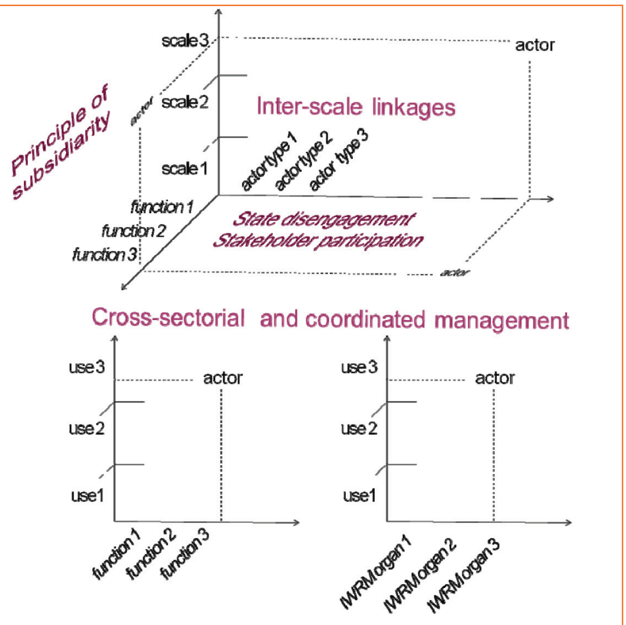

Fig. 2: Assessment of the different IWRM principles

MIMAT also evaluates the level of state disengagement in policy implementation and service providing functions. The assessment of these IWRM principles' implementation has been considered important in order to recommend reforms and actions towards integrated management of the resources. Additionally, during development of MIMAT, the identification of existing institutional arrangement allowing partial implementation of IWRM principles was also considered as important, since they could form potential foundations for further institutional development respecting the local context. According to the visualisation requirements different IWRM principles can be visualized by defining the X and the Y axis of the matrix (see fig. 2).

Principle of 'subsidiarity'

The principle of 'subsidiarity' encourages a decentralisation of the water/land/environment management functions, involving local partners in the management. The principle promotes decision making at the most local level possible, i.e. the closest possible to the resource utilisation level, with local stakeholders participating in decision implementation.

Inter-scale linkages. Deliberately evolving towards IWRM requires provisions for the state administration at all levels to mould the enabling environment in order to permit a decentralised and participative management. Stakeholder participation in the decision-making process and in the implementation ought to occur at all levels.

Principle of 'state disengagement'

In many countries most of the powers and authorities are still centralised in the national central administration. Development banks stimulate and encourage a state disengagement from policy implementation and service providing functions in the water sector in order to limit stranglehold situations where the central administration is judge in its own case. Many countries adopted this principle and enforce it through implementation of IWRM reforms. The disengagement principle is not put forward as an IWRM principle, but it goes hand in hand with the principle of stakeholder participation. This reshuffle and sharing out of responsibilities is visible in a matrix defined by the management functions and the categories of actors.

The principle of 'participation'

The participation principle encourages the participation of stakeholders from the civil society (including the users and the private sector) in the decision-making process and function implementation. This principle is reckoned as essential in the IWRM because it is considered as the most successful means for achieving long-lasting consensus and common agreement. Effective public involvement facilitating dialogue and consensus is considered by Hooper and Ward (2006) as a characteristic of a social decision system able of conflict resolution. Participation in the water resources management occurs directly when local communities gather together to decide on water management issues, or when democratically elected or otherwise accountable agencies or spokespersons represent stakeholder groups. As participation is more than consultation; it requires stakeholders at all levels of the social structure to have an impact on decisions at different levels of water management and to participate in the implementation. The participation of stakeholder should be underpinned by legal and institutional arrangements allowing or strengthening national, basin, or sub-basin consultation and coordination organisations (IWRM bodies). The visualisation of this principle should appear as management functions are implemented in a coordinated way by actors throughout the 3 families of actor (the state, the elected communities, and the civil society).

Principle of cross-sectoral management and coordinated management

A critically important element of IWRM is the integration of various sectoral views and interests in the decision-making process, with due attention given to upstream-downstream relationships. As an extension of the 'participation principle', agreements and consensus ought to be achieved with all relevant line ministries at all tiers of government, as well as with other stakeholders located in different parts of a river basin using the different basin resources. It's a way to plan water allocation across the entire basin, avoiding misallocation of water resources to one particular sector when higher value uses and users are denied services. As for the principle of subsidiarity, the principle of cross-sectoral management also requires attention at the decision implementation level. Since achieving consensus requests concessions of the water users, these commitments need to be substantiated through implementation of the decisions. The presence of consultative and participative IWRM type of organisation is an excellent sign of stakeholder participation and coordinated management.

Additional to the evaluation of the different IWRM principles, the tool allows also assessing legal gaps and overlaps by comparing the following institutional maps:

- "who is implementing which function de facto"
- "who is implementing which function de jure" (based on a legal mandate)
- "who is supposed to implement functions de jure".

First-level assessment

The first level assessment of the data and its visualisation allows ringing some alarm bells where problems of function assignment and bottlenecks in the implementation occur. Therefore the institutional expert is guided through a step-by-step multiple choice questionnaire, where the implementation of every single management function by the actors is assessed, in respect to the human resources (number and competences of personnel), in respect to the material and financial resources, and in respect to the actors collaboration with other actors for that particular function implementation. Gathering information with respect to collaboration with other actors provides a tool for the consultant to cross-check information. Cross-checking enhances the correctness of the database and by consequences also the mapping. It is the consultant's responsibility to complete the database with trustworthy and reliable information.

The matrix-based approach can consequently be used to visualize this first level assessment, mapping the actors relative to the management functions they are implementing, highlighting the actors in red, yellow and green indicating respectively if they experience problems, if the function is at risk or if the considered parameter is not an issue. Based on its expertise, the consultant will additionally provide an overall assessment of the actors' implementation based on its overall appreciation. The latter allows highlighting the management functions that are encountering problems, risks or no problems (red, yellow, and green). Figure 3 below shows an example of a matrix, where the function implementation has been plotted, related to the actor categories.

Conclusions

The MIMAT is powerful and flexible in the visualisation of the institutional landscape, of its bottlenecks and weaknesses. It provides a methodology, and the necessary materials to support consultant conclusions on the strengths and weaknesses of the legal and institutional framework. It supports the definition of reforms and actions to improve the said frameworks, and provides objective arguments to justify the proposed actions. The potential of MIMAT remains however dependent on the professional conscientiousness of the consultant and on the veracity of information input.

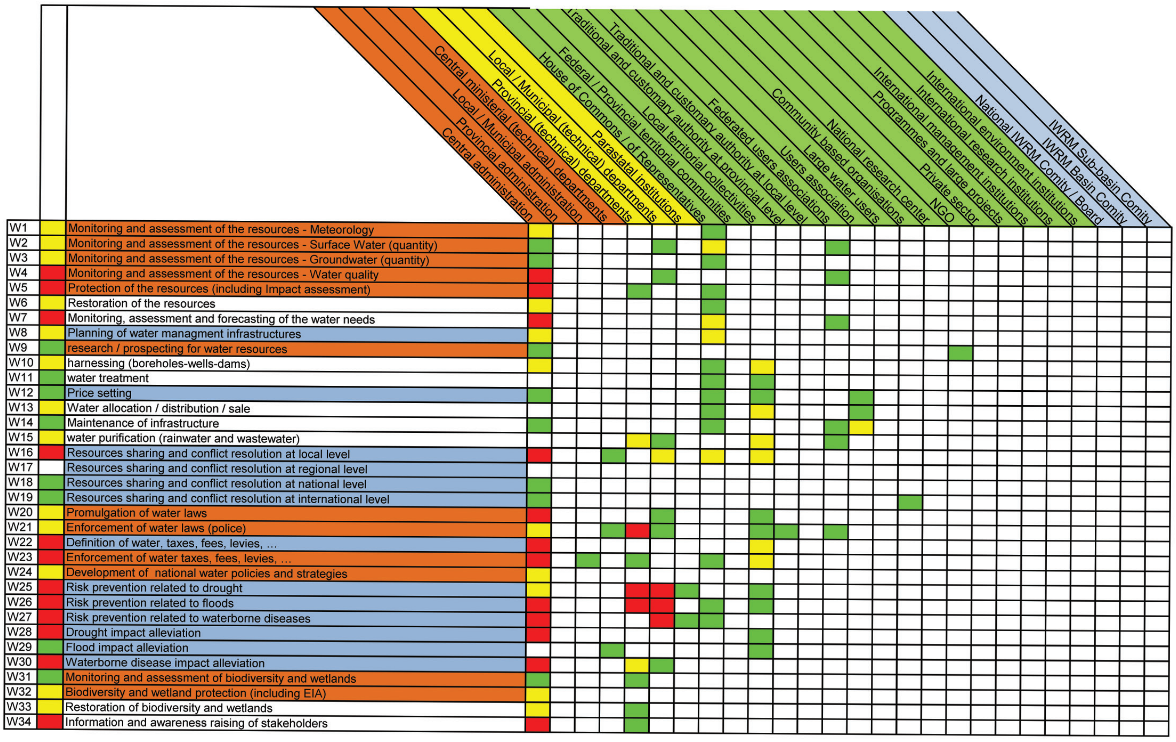

Fig. 3 example of a matrix (according to the old format), vizualisation of first level assessment of function implementation

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Annex 3. MIMAT Parameters.

For the actor analysis described in this report the following parameters have been defined and used:

Parameter 1: Categories of actors and type.

MIMAT distinguishes four actor families and within these families several categories of families can be defined. For this Mongolia case the selected categories that have been used in the analysis are listed below.

Parameter 2: Scale of operation.

Actors may be executing their functions at a variety of scales; this could be either administrative scales or natural scales. The scales that have been identified for this Mongolia case are listed below.

Family Code	Family of Actors
1	State
2	Elected Body
3	Civil Society
4	Consultative Body

Administrative Scales
Aimag [Province]
Bag [Ward]
District (municipal)
Khoroo [Ward] (municipal)
Municipality (town)
Soum [Village]
State (national)

Natural Scales
Gobi [Dessert]
Sub-River Basin
Khangai [Mountain forest]
Kheer [Steppe]
Multi-River Basin
National Historic Monument
National Park
Nature Reserve
River Basin
Stricktly Protected Area

Category of actors	Family
Gov. (Technical) Departments (Central)	1
Gov. (Technical) Departments (Regional)	1
Gov. (Technical) Departments (Local)	1
Public Administration (Central)	1
Public Administration (Regional)	1
Public Administration (Local)	1
Research Institutes and Universities	1
Elected Representative Bodies (Central)	2
Elected Representative Bodies (Regional)	2
Elected Representative Bodies (Local)	2
International Environment Institutions	3
International Financing Institutions	3
International Research Institutions	3
NGOs (National)	3
NGOs (Local)	3
Private Companies	3
Programs and (large) Projects	3
IWRM Organisations (Central)	4
IWRM Organisations (Basin)	4
IWRM Organisations (Sub-Basin)	4

The following water management actors have been included in the survey:

Actor Family 1	
Code	Actor name
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector

Actor Family 1 (cont'd)	
Code	Actor name
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office

Actor Family 2	
Code	Actor name
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural

Actor Family 3	
Code	Actor name
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAG)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness

Actor Family 4	
Code	Actor name
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Parameter 3: the possible management functions the actor may be executing,

The functions listed below have been identified as essential in respectively water, land and environment management and have been used in the analysis.

Functions in Water Management

01 Water Policy Making

W011	WATER POLICIES AND STRATEGY INITIATION AND DEVELOPMENT
W0111	public consultation for developing water policies/strategies
W0112	commission preparatory studies for developing water policies/strategies
W0113	prepare major water development plans/ investments
W0114	prepare budgets/resources/cost recovery/ subsidies for water development
W0115	prepare institutional development of water sector
W012	WATER POLICY DECISION-TAKING
W0121	decide on major water development plans/ investments
W0122	allocate budgets/resources for water development
W0123	decide on financing (sources/cost recovery/ subsidies) for water development
W0124	decide on institutional development of water sector
W013	MONITORING WATER POLICY IMPLEMENTATION/PERFORMANCE
W014	WATER (MANAGEMENT) POLICY COORDINATION
W0141	international coordination on water resources
W0142	coordination between water projects and/or policies
W0143	coordination between national and local level water policies

02 Water Legislation and Enforcement

W021	WATER LAW MAKING
W0211	developing water laws
W0212	developing water norms and regulations
W0213	developing water standards
W0214	approve and promulgate water laws
W0215	approve water norms and regulations
W0216	approve water standards
W022	INSPECTION AND ENFORCEMENT
W0221	inspection on water resource utilization
W0222	inspection on water resource protection
W0223	approve implementation of water works/ measures
W0224	approve operation and maintenance of water infrastructure
W0225	imposing corrective/punitive measures on transgressors of water laws

03 Water Resources Assessment and Monitoring

W032	QUALITATIVE WATER RESOURCES ASSESSMENT/MONITORING
W0321	assessment/monitoring of surface water - quality
W0322	assessment/monitoring of ground water - quality
W033	WATER (MANAGEMENT) ASSESSMENT AND MONITORING
W0331	water (management) impact assessment
W0332	assessment/monitoring of resource protection
W0333	assessment/monitoring of permafrost

04 Water Demand Assessment and Projection

W041	WATER DEMAND ASSESSMENT/MONITORING
W042	WATER DEMAND FORECASTING

05 Water (Management) Planning, Design and Costing	
W051	PLANNING AND BUDGETTING FOR WATER MANAGEMENT
W0511	develop water (management) scenario's and/or options
W0512	carry out/commission water (management) surveys/research
W0513	approval of water (management) study results
W0514	prospecting groundwater resources
W0515	public consultations on water (management)
W0516	select and approve water (management) plans and budgets
W0517	fund/resource reservation for water (management)
W052	DESIGN OF WATER MANAGEMENT INTERVENTIONS
W0521	design of water (management) measures/procedures
W0522	design of water (management) infrastructure
W0523	approve water (management) designs/measures/procedures

06 Water Resources and/or Services Allocation	
W061	LICENSING WATER USE
W0611	licensing withdrawal/abstraction of surface water
W0612	licensing withdrawal/abstraction of ground water
W0613	licensing trading in water
W062	LICENSING DISPOSAL ON WATER SYSTEM
W0621	licensing disposal of wastewater on water system
W0622	licensing disposal of waste on water system
W0623	licensing disposal of heat on water system
W063	LICENSING CONSTRUCTION OR INTERVENTIONS IN WATER SYSTEM
W0631	licensing constructions within the water system
W0632	licensing interferences in the water system
W064	LICENSING TRANSPORTATION OF WATER
W065	CERTIFICATION OF WATER PROFESSIONALS
W066	RESOLVING WATER (MANAGEMENT) CONFLICTS

07 Water Services Provision	
W071	WATER SUPPLY MANAGEMENT
W0711	supply of raw water
W0712	water treatment (drinking water)
W0713	distribution of treated water
W072	WASTE WATER MANAGEMENT
W0721	evacuation of waste water
W0722	treatment of waste water
W073	STORM WATER MANAGEMENT
W0731	evacuation of storm water
W0732	flood protection
W074	PROTECTION OF WATER RESOURCES
W0741	implement water resources protection measures/procedures
W0742	licensing interventions with water resource
W0743	water resources restoration measures
W076	WATER SERVICES INFRASTRUCTURE
W0761	construction (supervision) of water services infrastructure
W0762	operation and maintenance of water services infrastructure

08 Water Resources and/or Services Pricing	
W081	DEFINING WATER (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES
W082	COLLECTION OF WATER (MANAGEMENT) TAX/FEE/LEVIES/CHARGES
W0821	collection of tax/fee/levies/charges for withdrawal/use of water
W0822	collection of tax/fee/levies/charges for disposal of waste water/waste/heat
W0823	collection of tax/fee/levies/charges for interference with water management system
W0824	collection of tax/fee/levies/charges for water transportation
W0825	collection of tax/fee/levies/charges for water trading

09 Water Related Risk Management	
W091	WATER-RELATED RISK ASSESSMENT
W0911	assessment/monitoring of flood (risks)
W0912	assessment/monitoring of drought (risks)
W0913	assessment/monitoring of water-related health (risks)
W092	WATER-RELATED RISK REDUCTION/PREVENTION
W0921	flood risks reducing measures
W0922	drought risks reducing measures
W0923	water-related health risks reducing measures
W093	WATER-RELATED IMPACT ALLEVIATION
W0931	flood impact alleviation
W0932	drought impact alleviation
W0933	water-related health impact alleviation

10 Water Information Management	
W101	MANAGEMENT OF INFORMATION ON WATER FOR PROFESSIONAL USE
W1011	water (management) data collection
W1012	water (management) data storage
W1013	water (management) data exchange
W1014	water (management) data analysis
W1015	water (management) information exchange
W102	MANAGEMENT OF WATER INFORMATION FOR PUBLIC USE
W1021	water (management) information dissemination
W1022	public awareness campaigning on water (management)

Functions in Environmental Management (related to water)

01 Environment Policy Making	
E011	ENVIRONMENTAL POLICIES AND STRATEGY INITIATION AND DEVELOPMENT
E0111	public consultation for developing environmental policies/strategies
E0112	commission preparatory studies for developing environmental policies/strategies
E0113	prepare major environmental development plans/investments
E0114	prepare budgets/resources/cost recovery/ subsidies for environmental development
E0115	prepare institutional development of environment sector
E012	ENVIRONMENTAL POLICY DECISION-TAKING
E0121	decide on major environmental development plans/investments
E0122	allocate budgets/resources for environmental development
E0123	decide on financing (sources/cost recovery/ subsidies) for environmental development
E0124	decide on institutional development of environmental sector
E013	MONITORING ENVIRONMENTAL POLICY IMPLEMENTATION/PERFORMANCE
E014	COORDINATING ENVIRONMENTAL MANAGEMENT POLICIES
E0141	international coordination on environmental resources
E0142	coordination between environmental projects and/or policies
E0143	coordination between national and local level environmental policies

02 Environmental Legislation and Enforcement	
E021	ENVIRONMENTAL LAW MAKING
E0211	developing environmental laws
E0212	developing environmental norms and regulations
E0213	developing environmental standards
E0214	approve and promulgate environmental laws
E0215	approve environmental norms and regulations
E0216	approve environmental standards
E022	INSPECTION AND ENFORCEMENT
E0221	inspection on environmental protection
E0222	approve implementation of environmental restoration/conservation measures
E0223	imposing corrective/punitive measures on transgressors of environmental laws

03 Environmental Resources Assessment and Monitoring	
E031	ASSESSMENT/MONITORING ECO-SYSTEMS
E032	ASSESSMENT/MONITORING OF ENVIRONMENTAL PROTECTION

04 Environmental Demand Assessment and Projection	
E041	ASSESSMENT/MONITORING OF NEEDS FOR ENVIRONMENTAL SERVICES
E042	ENVIRONMENTAL NEEDS FORECASTING

05 Environmental (Management) Planning, Design and Costing	
E051	PLANNING AND BUDGETING FOR ENVIRONMENTAL MANAGEMENT
E0511	develop environmental (management) scenarios and/or options
E0512	carry out/commission environmental (management) surveys/research
E0513	approval of environmental (management) study results
E0514	public consultations on environmental (management)
E0515	select and approve environmental (management) plans and budgets
E0516	fund/resource reservation for environmental (management)
E052	DESIGN OF ENVIRONMENTAL MANAGEMENT INTERVENTIONS
E0521	design of environmental (management) measures/procedures
E0522	approve environmental (management) designs/ measures/procedures

06 Environmental Resources and/or Services Allocation	
E061	LICENSING ENVIRONMENT USE
E0611	licensing timber and fuel wood harvesting
E0612	licensing waste disposal in eco-system
E0613	licensing game resource use hunting and trapping
E0614	licensing natural flora use
E062	CERTIFICATION OF ENVIRONMENTAL PROFESSIONALS
E063	ENVIRONMENTAL (MANAGEMENT) CONFLICT RESOLUTION

07 Environmental Services Provision	
E071	ENVIRONMENTAL PROTECTION
E0711	allocating protection status (national park/ reserve/etc)
E0712	implement environmental protection measures/ procedures
E0713	licensing interventions with environmental resources
E072	RESTORATION OF ECO-SYSTEMS
E073	PROTECTING/MAINTAINING BIO-DIVERSITY
E074	RESTORATION OF BIO-DIVERSITY
E075	MAINTAINING ENVIRONMENTAL FLOW
E076	ENVIRONMENTAL IMPACT ASSESSMENT

08 Environmental Resources and/or Services Pricing	
E081	DEFINING ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES
E082	COLLECTION OF ENVIRONMENTAL (MANAGEMENT) TAXES / FEES / LEVIES and/or CHARGES
E0821	collection of taxes/fees/levies/charges for timber and fuel wood harvesting
E0822	collection of taxes/fees/levies/charges for waste disposal
E0823	collection of taxes/fees/levies/charges for game resource use hunting and trapping
E0824	collection of taxes/fees/levies/charges for natural flora use

09 Environment-related Risk Management	
E091	ENVIRONMENTAL RISK ASSESSMENT
E0911	assessment/monitoring of pollution (risks)
E0912	assessment/monitoring of fires (risk)
E0913	assessment/monitoring of pests/diseases (risks)
E0914	assessment/monitoring of unsustainable use (risks)
E092	ENVIRONMENT-RELATED RISK REDUCTION/ PREVENTION
E0921	pollution risks reducing measures
E0922	fire risks reducing measures
E0923	pests/diseases risks reducing measures
E0924	unsustainable use risks reducing measures
E093	ENVIRONMENT-RELATED IMPACT ALLEVIATION
E0931	pollution impact alleviation
E0932	unsustainable use impact alleviation

10 Environmental Information Management	
E101	MANAGEMENT OF INFORMATION ON ENVIRONMENT FOR PROFESSIONAL USE
E102	MANAGEMENT OF ENVIRONMENT INFORMATION FOR PUBLIC USE

Functions in Land Management (related to water)

01 Land (Management) Policy Making

L011	LAND POLICIES AND STRATEGY INTITIATION AND DEVELOPMENT
L0111	public consultation for developing land policies/ strategies
L0112	commission preparatory studies for developing land policies/strategies
L0113	prepare major land development plans/ investments
L0114	prepare budgets/resources/cost recovery/ subsidies for land development
L0115	prepare institutional development of land sector
L012	LAND POLICY DECISION-TAKING
L0121	decide on major land development plans/ investments
L0122	allocate budgets/resources for land development
L0123	decide on financing (sources/cost recovery/ subsidies) for land development
L0124	decide on institutional development of land sector
L013	MONITORING LAND POLICY IMPLEMENTATION/ PERFORMANCE
L014	COORDINATION OF LAND MANAGEMENT POLICIES
L0141	coordination between land (management) projects and/or policies
L0142	coordination between national and local level land policies

02 Land (Management) Legislation and Enforcement

L021	LAND LAW MAKING
L0211	develop land laws
L0212	develop land norms and regulations
L0213	approve and promulgate land laws
L0214	approve land norms and regulations
L022	INSPECTION AND ENFORCEMENT
L0221	inspection on land resources protection
L0222	imposing corrective/punitive measures on transgressors of land laws

03 Land Resources Assessment and Monitoring

04 Land Use Needs Assessment and Projection

05 Land(Management) Planning, Design and Costing

L051	SPATIAL PLANNING AND LAND USE ALLOCATION

06 Land Services Allocation

07 Land Services Provision

L071	LAND DEGREDATION/SOIL EROSION PROTECTION
L0711	implement land/soil protection measures/ procedures
L0712	land restoration measures

08 Land Resources and/or Services Pricing

L081	DEFINING LAND TAXES/FEES/LEVIES/CHARGES
L082	COLLECTION OF LAND TAXES/FEES/LEVIES/ CHARGES

09 Land-related Risk Management

L091	LAND USE RELATED RISK ASSESSMENT
L0911	assessment/monitoring of fertilizer/pesticide use (risks)
L0912	assessment/monitoring of pests/diseases (risks)
L092	LAND-RELATED RISK REDUCTION/PREVENTION
L0921	risks reducing measures for fertilizer/pesticide use
L0922	pests/diseases risks reducing measures

10 Land Information Management

Parameter 4: the possible water, land and environmental uses the actor may be governing,

The uses listed below have been identified and used in the analysis for water, environmental and land management respectively.

Water, environmental and land uses

Water Uses

W	ALL WATER USES
W1	All Drinking Water Uses
W11	urban drinking water
W12	semi-urban drinking water
W13	rural drinking water
W2	All Agricultural Uses
W21	rain fed crop production
W22	crop irrigation
W23	livestock watering
W24	pasture irrigation (hay making)
W3	All Industrial Uses
W31	mining exploitation
W32	food & light industries
W33	thermo-power plants & heating system
W4	All Non-consumptive Uses
W41	hydro-electricity
W42	navigation
W5	All flood protection/drainage uses
W51	flood protection
W52	storm water drainage
W6	All Recreational Uses
W61	tourist camps
W62	fishery and hunting
W63	spa/health resorts
W7	All Environmental Uses
W71	wetlands conservation
W72	environmental flow
W8	All Disposal Uses
W81	urban waste water disposal
W82	industrial waste water disposal

Environmental Uses

E	ALL ENVIRONMENTAL USES
E1	All Regulating Uses
E11	regulating climate
E12	regulating floods
E13	regulating diseases
E14	regulating water quality
E15	regulating water supply
E2	All Supply Uses
E21	supply of food/fruits
E22	supply of fibers/timber
E23	supply of water
E24	supply of medicinal products
E25	supply of firewood
E3	All Sustainability Uses
E31	soil formation
E32	pollination
E33	nutrient cycle
E34	sustaining biodiversity
E4	All Other Environmental Uses
E41	spiritual services (sacred springs/forests etc)
E42	aesthetical services
E43	Recreational services

Land Uses

L	ALL LAND USES
L1	Urban Land Uses
L2	Agricultural Land Uses
L21	pasture
L3	Mining Exploitation
L4	Recreational Land Uses
L5	Forestry Uses
L6	Environmental Land Uses
L7	Other Land Uses

Annex 4: MIMAT output; State Disengagement Matrices

State disengagement matrices are included for all the identified functions in water management, land management and environmental management (for as far as the functions have a bearing on water). In the matrices the actor families are coded by colours as follows:

- blue: the state
- red: elected bodies
- orange: civil society
- green: iwrm bodies

The actor families are subdivided in categories, which in most cases divide the families in state and local levels.

On the vertical axis of the matrices all the functions in water management, land management and environmental management are listed. In the matrices the actors are listed for the functions they have been found to have a responsibility in the column of the category of actors they belong to. The actors are listed by their numerical code of which a legend is provided on the right side of the matrices. The colour of the actor code indicates whether the actor is performing the function regularly or on an ad hoc basis – in some cases this could not be ascertained and a grey colour is used. For actors who are only engaged in functions on an ad hoc basis it is more difficult to be held accountable and only in exceptional cases should responsibility for functions be assigned to actors on an ad hoc basis.

In the State Disengagement the functions listed in the leftmost column are coloured in the colour of the actor family that would ultimately be supposed to be responsible for the function for effective IWRM. Allowing for a stepwise completion of the transfer of responsibilities the matrices show the desired situation in 2015 (intermediate phase) and 2021 (end phase). The coloured fields in the matrices indicate which category of actors should be responsible for the functions by 2015 and 2021 respectively. All actors currently engaged in a particular function and are placed outside the coloured boxes in the matrices would thus be relieved from that function and the function would be assigned to an actor inside the coloured box. After 2015 the transfers would continue for the functions and actors as indicated in the right side half of the matrices.

Also within the coloured boxes transfers could be considered in particular with respect to decentralizing functions. Functions currently the responsibility of national level organisations could be considered for transfer to local level organisations.

State Disengagement from Water Management Functions
Present Situation and Desired Situations as per 2015 and as per 2021

mimat

Color legend for Actor-code:
3,32: regular
4,20: ad hoc / irregular
4,10: undefined

Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State: Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W011 WATER POLICIES AND STRATEGY INITIATION AND DEVELOPMENT																				
W0111 public consultation for developing water policies/strategies	1,10			1,11				2,00											4,10	4,20
W0112 commission preparatory studies for developing water policies/strategies	1,10			1,11	1,75							3,10						1,01	4,10	4,20
	1,20			1,41																
	1,30																			
	1,40																			
	1,50																			
W0113 prepare major water development plans/investments	1,00			1,11	1,75							3,10						1,01		
	1,10			1,41																
	1,20																			
	1,30																			
	1,40																			
W0114 prepare budgets/resources/cost recovery/subsidies for water development	1,00			1,11	1,75													1,01		
	1,10			1,41																
	1,20																			
	1,30																			
	1,40																			
W0115 prepare institutional development of water sector	1,00																	1,01		
	1,10																			
	1,20																			
W012 WATER POLICY DECISION-TAKING																				
W0121 decide on major water development plans/investments								2,00	2,10											
W0122 allocate budgets/resources for water development								2,00	2,10											
W0123 decide on financing (sources/cost recovery/subsidies) for water development								2,00	2,10											
W0124 decide on institutional development of water sector								2,00												
W013 MONITORING WATER POLICY IMPLEMENTATION/PERFORMANCE	1,10			1,11				2,00	2,10					3,32					4,10	4,20
W014 WATER (MANAGEMENT) POLICY COORDINATION	1,00																			
W0141 international coordination on water resources	1,00																	1,01		
	1,10																			
W0142 coordination between water projects and/or policies	1,00	1,80	1,70															1,01	4,10	4,20
	1,10																			
	1,60																			
W0143 coordination between national and local level water policies	1,10	1,80	1,70						2,10											
W021 WATER LAW MAKING																				
W0211 developing water laws	1,00							2,00												
	1,10																			
	1,20																			
	1,30																			
	1,40																			
	1,50																			
W0212 developing water norms and regulations	1,10			1,11			1,51													
	1,20			1,13																
	1,30			1,21																
	1,50																			

STATE DISENGAGEMENT as per 2021

Functions	State: Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W011 WATER POLICIES AND STRATEGY INITIATION AND DEVELOPMENT																				
W0111 public consultation for developing water policies/strategies	1,10			1,11				2,00											4,10	4,20
W0112 commission preparatory studies for developing water policies/strategies	1,10			1,11	1,75							3,10						1,01	4,10	4,20
	1,20			1,41																
	1,30																			
	1,40																			
	1,50																			
W0113 prepare major water development plans/investments	1,00			1,11	1,75							3,10						1,01		
	1,10			1,41																
	1,20																			
	1,30																			
	1,40																			
W0114 prepare budgets/resources/cost recovery/subsidies for water development	1,00			1,11	1,75													1,01		
	1,10			1,41																
	1,20																			
	1,30																			
	1,40																			
W0115 prepare institutional development of water sector	1,00																	1,01		
	1,10																			
	1,20																			
W012 WATER POLICY DECISION-TAKING																				
W0121 decide on major water development plans/investments								2,00	2,10											
W0122 allocate budgets/resources for water development								2,00	2,10											
W0123 decide on financing (sources/cost recovery/subsidies) for water development								2,00	2,10											
W0124 decide on institutional development of water sector								2,00												
W013 MONITORING WATER POLICY IMPLEMENTATION/PERFORMANCE	1,10			1,11				2,00	2,10					3,32					4,10	4,20
W014 WATER (MANAGEMENT) POLICY COORDINATION	1,00																			
W0141 international coordination on water resources	1,00																	1,01		
	1,10																			
W0142 coordination between water projects and/or policies	1,00	1,80	1,70															1,01	4,10	4,20
	1,10																			
	1,60																			
W0143 coordination between national and local level water policies	1,10	1,80	1,70						2,10											
W021 WATER LAW MAKING																				
W0211 developing water laws	1,00							2,00												
	1,10																			
	1,20																			
	1,30																			
	1,40																			
	1,50																			
W0212 developing water norms and regulations	1,10			1,11			1,51													
	1,20			1,13																
	1,30			1,21																
	1,50																			

Code	Actor name
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural

State Disengagement from Water Management Functions
Present Situation and Desired Situations as per 2015 and as per 2021

Color legend for Actor-code:
3,32: regular
4,20: ad hoc / irregular
4,10: undefined

Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W0213 developing water standards	1,10			1,05																
	1,20																			
	1,30																			
	1,50																			
W0214 approve and promulgate water laws								2,00												
W0215 approve water norms and regulations	1,10						1,51													
	1,20																			
	1,30																			
	1,50																			
W0216 approve water standards				1,05																
W022 INSPECTION AND ENFORCEMENT																				
W0221 inspection on water resource utilization	1,10			1,11															4,10	4,20
W0222 inspection on water resource protection	1,10			1,11															4,10	4,20
W0223 approve implementation of water works/measures	1,10																			
W0224 approve operation and maintenance of water infrastructure																				
W0225 imposing corrective/punitive measures on transgressors of water laws																			4,10	4,20
W031 QUANTITATIVE WATER RESOURCES ASSESSMENT/MONITORING	1,10																			
W0311 assessment/monitoring of meteoric water							1,15													
W0312 assessment/monitoring of surface water				1,11	1,73	1,82	1,15													
					1,74															
W0313 assessment/monitoring of ground water				1,11			1,06									3,01				
				1,42												3,03				
W0314 assessment/monitoring of springs				1,11			1,51													
				1,42																
W0315 assessment/monitoring of glaciers							1,15													
W032 QUALITATIVE WATER RESOURCES ASSESSMENT/MONITORING	1,10																			
W0321 assessment/monitoring of surface water - quality				1,03	1,71		1,06													
				1,04																
				1,11																
				1,14																
W0322 assessment/monitoring of ground water - quality				1,03			1,06									3,01				
				1,04																
				1,11												3,03				
W033 WATER (MANAGEMENT) ASSESSMENT AND MONITORING	1,10						1,06													
W0331 water (management) impact assessment																			4,10	
W0332 assessment/monitoring of resource protection				1,11			1,15												4,10	4,20
W0333 assessment/monitoring of permafrost							1,15													
W041 WATER DEMAND ASSESSMENT/MONITORING	1,10	1,80	1,70	1,02			1,06													
	1,30			1,11																
				1,21																
				1,41																
				1,42																
W042 WATER DEMAND FORECASTING	1,10			1,11																
	1,20			1,41																
	1,30			1,42																

STATE DISENGAGEMENT as per 2021

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W0213 developing water standards	1,10			1,05																
	1,20																			
	1,30																			
	1,50																			
W0214 approve and promulgate water laws								2,00												
W0215 approve water norms and regulations	1,10						1,51													
	1,20																			
	1,30																			
	1,50																			
W0216 approve water standards				1,05																
W022 INSPECTION AND ENFORCEMENT																				
W0221 inspection on water resource utilization	1,10			1,11															4,10	4,20
W0222 inspection on water resource protection	1,10			1,11															4,10	4,20
W0223 approve implementation of water works/measures	1,10																			
W0224 approve operation and maintenance of water infrastructure																				
W0225 imposing corrective/punitive measures on transgressors of water laws																			4,10	4,20
W031 QUANTITATIVE WATER RESOURCES ASSESSMENT/MONITORING	1,10																			
W0311 assessment/monitoring of meteoric water							1,15													
W0312 assessment/monitoring of surface water				1,11	1,73	1,82	1,15													
					1,74															
W0313 assessment/monitoring of ground water				1,11			1,06									3,01				
				1,42												3,03				
W0314 assessment/monitoring of springs				1,11			1,51													
				1,42																
W0315 assessment/monitoring of glaciers							1,15													
W032 QUALITATIVE WATER RESOURCES ASSESSMENT/MONITORING	1,10																			
W0321 assessment/monitoring of surface water - quality				1,03	1,71		1,06													
				1,04																
				1,11																
				1,14																
W0322 assessment/monitoring of ground water - quality				1,03			1,06									3,01				
				1,04																
				1,11												3,03				
W033 WATER (MANAGEMENT) ASSESSMENT AND MONITORING	1,10						1,06													
W0331 water (management) impact assessment																			4,10	
W0332 assessment/monitoring of resource protection				1,11			1,15												4,10	4,20
W0333 assessment/monitoring of permafrost							1,15													
W041 WATER DEMAND ASSESSMENT/MONITORING	1,10	1,80	1,70	1,02			1,06													
	1,30			1,11																
				1,21																
				1,41																
				1,42																
W042 WATER DEMAND FORECASTING	1,10			1,11																
	1,20			1,41																
	1,30			1,42																

2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp.
3,02	Housing Services Comp. (OCHAAK)
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,37	Nat. level NGOs Legisl. & Policy Renewal
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

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State Disengagement from Water Management Functions
Present Situation and Desired Situations as per 2015 and as per 2021

Color legend for Actor-code:
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4,10: undefined

Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
W051 PLANNING AND BUDGETTING FOR WATER MANAGEMENT																				
W0511 develop water (management) scenario's and/or options	1,10 1,20 1,30			1,11 1,41 1,42															4,10	
W0512 carry out/commission water (management) surveys/research	1,30 1,40			1,11 1,42			1,06													
W0513 approval of water (management) study results	1,10 1,20 1,30 1,40			1,11																
W0514 prospecting groundwater resources				1,42			1,06									3,21				
W0515 public consultations on water (management)				1,11															4,10	4,20
W0516 select and approve water (management) plans and budgets	1,00 1,10 1,20 1,30 1,40							2,00												
W0517 fund/resource reservation for water (management)	1,10 1,20 1,30 1,40			1,11																
W052 DESIGN OF WATER MANAGEMENT INTERVENTIONS																				
W0521 design of water (management) measures/procedures				1,11																
W0522 design of water (management) infrastructure	1,30			1,21 1,41			1,06													
W0523 approve water (management) designs/measures/procedures				1,21																
W061 LICENSING WATER USE																				
W0611 licensing withdrawal/abstraction of surface water	1,10																			
W0612 licensing withdrawal/abstraction of ground water	1,10	1,80																		
W0613 licensing trading in water	1,20	1,80																		
W062 LICENSING DISPOSAL ON WATER SYSTEM																				
W0621 licensing disposal of wastewater on water system																				
W0622 licensing disposal of waste on water system																				
W0623 licensing disposal of heat on water system																				
W063 LICENSING CONSTRUCTION/INTERVENTIONS IN WATER SYSTEM																				
W0631 licensing constructions within the water system																				
W0632 licensing interferences in the water system	1,10																			
W064 LICENSING TRANSPORTATION OF WATER	1,20	1,80																		
W065 CERTIFICATION OF WATER PROFESSIONALS	1,10 1,20																			
W066 RESOLVING WATER (MANAGEMENT) CONFLICTS		1,80			1,71														4,10	4,20

STATE DISENGAGEMENT as per 2021

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
W051 PLANNING AND BUDGETTING FOR WATER MANAGEMENT																				
W0511 develop water (management) scenario's and/or options	1,10 1,20 1,30			1,11 1,41 1,42															4,10	
W0512 carry out/commission water (management) surveys/research	1,30 1,40			1,11 1,42			1,06													
W0513 approval of water (management) study results	1,10 1,20 1,30 1,40			1,11																
W0514 prospecting groundwater resources				1,42			1,06									3,21				
W0515 public consultations on water (management)				1,11															4,10	4,20
W0516 select and approve water (management) plans and budgets	1,00 1,10 1,20 1,30 1,40							2,00												
W0517 fund/resource reservation for water (management)	1,10 1,20 1,30 1,40			1,11																
W052 DESIGN OF WATER MANAGEMENT INTERVENTIONS																				
W0521 design of water (management) measures/procedures				1,11																
W0522 design of water (management) infrastructure	1,30			1,21 1,41			1,06													
W0523 approve water (management) designs/measures/procedures				1,21																
W061 LICENSING WATER USE																				
W0611 licensing withdrawal/abstraction of surface water	1,10																			
W0612 licensing withdrawal/abstraction of ground water	1,10	1,80																		
W0613 licensing trading in water	1,20	1,80																		
W062 LICENSING DISPOSAL ON WATER SYSTEM																				
W0621 licensing disposal of wastewater on water system																				
W0622 licensing disposal of waste on water system																				
W0623 licensing disposal of heat on water system																				
W063 LICENSING CONSTRUCTION/INTERVENTIONS IN WATER SYSTEM																				
W0631 licensing constructions within the water system																				
W0632 licensing interferences in the water system	1,10																			
W064 LICENSING TRANSPORTATION OF WATER	1,20	1,80																		
W065 CERTIFICATION OF WATER PROFESSIONALS	1,10 1,20																			
W066 RESOLVING WATER (MANAGEMENT) CONFLICTS		1,80			1,71														4,10	4,20

State Disengagement from Water Management Functions
Present Situation and Desired Situations as per 2015 and as per 2021

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Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015 — Functions	State: Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W071 WATER SUPPLY MANAGEMENT																				
W0711 allocate of raw water																3,21				
W0712 distribution of treated water		1,80														3,01				
																3,03				
																3,21				
																3,23				
W0712 water treatment (drinking water)																3,01				
																3,02				
																3,03				
																3,21				
																3,23				
W072 WASTE WATER MANAGEMENT																				
W0721 evacuation of waste water																3,01				
																3,02				
																3,03				
																3,21				
																3,24				
																3,25				
W0722 treatment of waste water																3,01				
																3,03				
																3,21				
																3,24				
																3,25				
W073 STORM WATER MANAGEMENT																				
W0731 evacuation of storm water		1,80	1,70																	
W0732 flood protection		1,80	1,70																	
W074 PROTECTION OF WATER RESOURCES																				
W0741 implement water resources protection measures/procedures	1,10	1,80		1,11	1,73														4,10	4,20
W0742 licensing interventions with water resource	1,10																			
W0743 water resources restoration measures	1,10	1,80		1,11	1,73														4,10	4,20
				1,12																
W076 WATER SERVICES INFRASTRUCTURE																3,21				
W0761 construction (supervision) of water services infrastructure		1,80		1,41	1,75							3,10				3,01				
					1,76											3,03				
																3,22				
W0762 operation and maintenance of water services infrastructure		1,80	1,70	1,41												3,01				
																3,02				
																3,03				
																3,23				
																3,24				
																3,25				
W081 DEFINING WATER (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES		1,80						2,00	2,10	2,20						3,21				

STATE DISENGAGEMENT as per 2021 — Functions	State: Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W071 WATER SUPPLY MANAGEMENT																				
W0711 allocate of raw water																3,21				
W0712 distribution of treated water		1,80														3,01				
																3,03				
																3,21				
																3,23				
W0712 water treatment (drinking water)																3,01				
																3,02				
																3,03				
																3,21				
																3,23				
W072 WASTE WATER MANAGEMENT																				
W0721 evacuation of waste water																3,01				
																3,02				
																3,03				
																3,21				
																3,24				
																3,25				
W0722 treatment of waste water																3,01				
																3,03				
																3,21				
																3,24				
																3,25				
W073 STORM WATER MANAGEMENT																				
W0731 evacuation of storm water		1,80	1,70																	
W0732 flood protection		1,80	1,70																	
W074 PROTECTION OF WATER RESOURCES																				
W0741 implement water resources protection measures/procedures	1,10	1,80		1,11	1,73														4,10	4,20
W0742 licensing interventions with water resource	1,10																			
W0743 water resources restoration measures	1,10	1,80		1,11	1,73														4,10	4,20
				1,12																
W076 WATER SERVICES INFRASTRUCTURE																3,21				
W0761 construction (supervision) of water services infrastructure		1,80		1,41	1,75							3,10				3,01				
					1,76											3,03				
																3,22				
W0762 operation and maintenance of water services infrastructure		1,80	1,70	1,41												3,01				
																3,02				
																3,03				
																3,23				
																3,24				
																3,25				
W081 DEFINING WATER (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES		1,80						2,00	2,10	2,20						3,21				

State Disengagement from Water Management Functions
Present Situation and Desired Situations as per 2015 and as per 2021

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Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W082 COLLECTION OF WATER (MANAGEMENT) TAX/FEE/LEVIES/CHARGES																				
W0821 collection of tax/fee/levies/charges for withdrawal/use of water				1,61	1,78															
W0822 collection of tax/fee/levies/charges for disposal of waste water/waste/heat																				
W0823 collection of tax/fee/levies/charges for interference with water management system				1,03																
W0824 collection of tax/fee/levies/charges for water transportation				1,61												3,01				
																3,02				
																3,03				
																3,21				
																3,23				
W0825 collection of tax/fee/levies/charges for water trading				1,61												3,01				
																3,02				
																3,03				
																3,21				
																3,24				
																3,25				
W091 WATER-RELATED RISK ASSESSMENT				1,11																
W0911 assessment/monitoring of flood (risks)		1,80	1,70	1,13			1,15													
W0912 assessment/monitoring of drought (risks)	1,10	1,80	1,70	1,13																
				1,41																
W0913 assessment/monitoring of water-related health (risks)	1,50				1,77		1,51													
W092 WATER-RELATED RISK REDUCTION/PREVENTION				1,11																
W0921 flood risks reducing measures		1,80	1,70	1,02	1,72															
W0922 drought risks reducing measures	1,10	1,80	1,70																	
	1,30																			
W0923 water-related health risks reducing measures	1,50																			
W093 WATER-RELATED IMPACT ALLEVIATION				1,11																
W0931 flood impact alleviation		1,80	1,70	1,02	1,72															
W0932 drought impact alleviation	1,10	1,80	1,70	1,02	1,72															
	1,30																			
W0933 water-related health impact alleviation																				

STATE DISENGAGEMENT as per 2021

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W082 COLLECTION OF WATER (MANAGEMENT) TAX/FEE/LEVIES/CHARGES																				
W0821 collection of tax/fee/levies/charges for withdrawal/use of water				1,61	1,78															
W0822 collection of tax/fee/levies/charges for disposal of waste water/waste/heat																				
W0823 collection of tax/fee/levies/charges for interference with water management system				1,03																
W0824 collection of tax/fee/levies/charges for water transportation				1,61												3,01				
																3,02				
																3,03				
																3,21				
																3,23				
W0825 collection of tax/fee/levies/charges for water trading				1,61												3,01				
																3,02				
																3,03				
																3,21				
																3,24				
																3,25				
W091 WATER-RELATED RISK ASSESSMENT				1,11																
W0911 assessment/monitoring of flood (risks)		1,80	1,70	1,13			1,15													
W0912 assessment/monitoring of drought (risks)	1,10	1,80	1,70	1,13																
				1,41																
W0913 assessment/monitoring of water-related health (risks)	1,50				1,77		1,51													
W092 WATER-RELATED RISK REDUCTION/PREVENTION				1,11																
W0921 flood risks reducing measures		1,80	1,70	1,02	1,72															
W0922 drought risks reducing measures	1,10	1,80	1,70																	
	1,30																			
W0923 water-related health risks reducing measures	1,50																			
W093 WATER-RELATED IMPACT ALLEVIATION				1,11																
W0931 flood impact alleviation		1,80	1,70	1,02	1,72															
W0932 drought impact alleviation	1,10	1,80	1,70	1,02	1,72															
	1,30																			
W0933 water-related health impact alleviation																				

State Disengagement from Water Management Functions
Present Situation and Desired Situations as per 2015 and as per 2021

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Color legend for Actor-code:
3,32: regular
4,20: ad hoc / irregular
4,10: undefined

Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W101 MANAGEMENT OF INFORMATION ON WATER FOR PROFESSIONAL USE																				
W1011 water (management) data collection	1,30	1,80	1,70	1,04	1,71		1,06							3,32		3,01				4,20
	1,50			1,11	1,73		1,15									3,02				
				1,13	1,75		1,51									3,03				
				1,21	1,76											3,21				
				1,41												3,22				
				1,42												3,23				
																3,24				
																3,25				
W1012 water (management) data storage				1,04												3,22				
				1,11																
				1,42																
W1013 water (management) data exchange				1,04												3,22				
				1,11																
				1,42																
W1014 water (management) data analysis	1,30			1,04			1,06							3,32		3,21				
				1,11			1,15									3,22				
				1,13			1,51													
				1,21																
				1,41																
				1,42																
W1015 water (management) information exchange	1,30			1,11			1,06							3,32		3,21				
				1,13			1,15									3,22				
				1,21			1,51													
				1,41																
				1,42																
W102 MANAGEMENT OF WATER INFORMATION FOR PUBLIC USE																				4,20
W1021 water (management) information dissemination	1,10	1,80	1,70	1,11	1,73		1,51							3,31	3,41	3,01			4,10	4,20
	1,20				1,77									3,32		3,02				
	1,30													3,35		3,03				
	1,40																			
	1,50																			
W1022 public awareness campaigning on water (management)	1,10		1,70	1,11	1,77		1,51							3,31	3,41	3,01			4,10	4,20
	1,20													3,32		3,02				
	1,40													3,35		3,03				
	1,50																			

STATE DISENGAGEMENT as per 2021

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
W101 MANAGEMENT OF INFORMATION ON WATER FOR PROFESSIONAL USE																				
W1011 water (management) data collection	1,30	1,80	1,70	1,04	1,71		1,06							3,32		3,01				4,20
	1,50			1,11	1,73		1,15									3,02				
				1,13	1,75		1,51									3,03				
				1,21	1,76											3,21				
				1,41												3,22				
				1,42												3,23				
																3,24				
																3,25				
W1012 water (management) data storage				1,04												3,22				
				1,11																
				1,42																
W1013 water (management) data exchange				1,04												3,22				
				1,11																
				1,42																
W1014 water (management) data analysis	1,30			1,04			1,06							3,32		3,21				
				1,11			1,15									3,22				
				1,13			1,51													
				1,21																
				1,41																
				1,42																
W1015 water (management) information exchange	1,30			1,11			1,06							3,32		3,21				
				1,13			1,15									3,22				
				1,21			1,51													
				1,41																
				1,42																
W102 MANAGEMENT OF WATER INFORMATION FOR PUBLIC USE																				4,20
W1021 water (management) information dissemination	1,10	1,80	1,70	1,11	1,73		1,51							3,31	3,41	3,01			4,10	4,20
	1,20				1,77									3,32		3,02				
	1,30													3,35		3,03				
	1,40																			
	1,50																			
W1022 public awareness campaigning on water (management)	1,10		1,70	1,11	1,77		1,51							3,31	3,41	3,01			4,10	4,20
	1,20													3,32		3,02				
	1,40													3,35		3,03				
	1,50																			

State Disengagement from Environmental Management Functions (related to water management)
Present Situation and Desired Situations as per 2015 and as per 2021

Color legend for Actor-code:
3,32: regular
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Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
E011 ENVIRONMENTAL POLICIES AND STRATEGY INITIATION AND DEVELOPMENT																				
E0111 public consultation for developing environmental policies/strategies	1,00							2,00	2,10											
	1,10																			
E0112 commission preparatory studies for developing environmental policies/strategies	1,10											3,10							4,10	4,20
	1,60																			
E0113 prepare major environmental development plans/investments	1,10											3,10								
E0114 prepare budgets/resources/cost recovery/subsidies for environmental developme	1,10											3,10								
E0115 prepare institutional development of environment sector	1,10																			
E012 ENVIRONMENTAL POLICY DECISION-TAKING																				
E0121 decide on major environmental development plans/investments								2,00												4,20
E0122 allocate budgets/resources for environmental development	1,10							2,00	2,10	2,20										
E0123 decide on financing (sources/cost recovery/subsidies) for environmental development								2,00	2,10	2,20										
E0124 decide on institutional development of environmental sector								2,00												
E013 MONITORING ENVIRONMENTAL POLICY IMPLEMENTATION/PERFORMANCE	1,10				1,71			2,00	2,10	2,20				3,32	3,39					
														3,33						
E014 COORDINATING ENVIRONMENTAL MANAGEMENT POLICIES																				
E0141 international coordination on environmental resources	1,00																			
	1,10																			
E0142 coordination between environmental projects and/or policies	1,00		1,70																	
	1,10																			
	1,60																			
E0143 coordination between national and local level environmental policies	1,00		1,70																	
E021 ENVIRONMENTAL LAW MAKING																				
E0211 developing environmental laws	1,10																			
E0212 developing environmental norms and regulations	1,10			1,11																
				1,12																
E0213 developing environmental standards	1,10			1,05																
				1,11																
				1,12																
E0214 approve and promulgate environmental laws								2,00												
E0215 approve environmental norms and regulations																				
E0216 approve environmental standards				1,05																
E022 INSPECTION AND ENFORCEMENT																				
E0221 inspection on environmental protection	1,10			1,03	1,71	1,81														
					1,73	1,82														
E0222 approve implementation of environmental restoration/conservation measures	1,10				1,71															
					1,73															
E0223 imposing corrective/punitive measures on transgressors of environmental laws				1,03	1,71	1,81														
E031 ASSESSMENT/MONITORING ECO-SYSTEMS	1,10			1,12			1,15												4,10	4,20
				1,14																
E032 ASSESSMENT/MONITORING OF ENVIRONMENTAL PROTECTION	1,10			1,12	1,73									3,32					4,10	4,20
														3,33						

STATE DISENGAGEMENT as per 2021

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
E011																				
E0111	1,00							2,00	2,10											
	1,10																			
E0112	1,10											3,10							4,10	4,20
	1,60																			
E0113	1,10											3,10								
E0114	1,10											3,10								
E0115	1,10																			
E012																				
E0121								2,00												4,20
E0122	1,10							2,00	2,10	2,20										
E0123								2,00	2,10	2,20										
E0124								2,00												
E013	1,10				1,71			2,00	2,10	2,20				3,32	3,39					
														3,33						
E014																				
E0141	1,00																			
	1,10																			
E0142	1,00		1,70																	
	1,10																			
	1,60																			
E0143	1,00		1,70																	
E021																				
E0211	1,10																			
E0212	1,10			1,11																
				1,12																
E0213	1,10			1,05																
				1,11																
				1,12																
E0214								2,00												
E0215																				
E0216				1,05																
E022																				
E0221	1,10			1,03	1,71	1,81														
					1,73	1,82														
E0222	1,10				1,71															
					1,73															
E0223				1,03	1,71	1,81														
E031	1,10			1,12			1,15												4,10	4,20
				1,14																
E032	1,10			1,12	1,73												3,32		4,10	4,20
																	3,33			

Code	Actor_name
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia

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State Disengagement from Environmental Management Functions (related to water management)
Present Situation and Desired Situations as per 2015 and as per 2021

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Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
E041 ASSESSMENT/MONITORING OF NEEDS FOR ENVIRONMENTAL SERVICES	1,10				1,73									3,32						4,20
														3,33						
														3,36						
E042 ENVIRONMENTAL NEEDS FORECASTING	1,10													3,36					4,10	
														3,38						4,20
E051 PLANNING AND BUDGETING FOR ENVIRONMENTAL MANAGEMENT																				
E0511 develop environmental (management) scenarios and/or options	1,10			1,11			1,15												4,10	
E0512 carry out/commission environmental (management) surveys/research	1,10																			
E0513 approval of environmental (management) study results	1,10																			
E0514 public consultations on environmental (management)	1,10			1,11																
E0515 select and approve environmental (management) plans and budgets	1,10																			
E0516 fund/resource reservation for environmental (management)	1,10	1,80																		4,20
	1,40																			
E052 DESIGN OF ENVIRONMENTAL MANAGEMENT INTERVENTIONS																				
E0521 design of environmental (management) measures/procedures	1,10			1,11															4,10	4,20
E0522 approve environmental (management) designs/measures/procedures	1,10																			
E061 LICENSING ENVIRONMENT USE																				
E0611 licensing timber and fuel wood harvesting	1,10				1,73															
E0612 licensing waste disposal in eco-system																				
E0613 licensing game resource use hunting and trapping																				
E0614 licensing natural flora use					1,73															
E062 CERTIFICATION OF ENVIRONMENTAL PROFESSIONALS	1,10																			
E063 ENVIRONMENTAL (MANAGEMENT) CONFLICT RESOLUTION	1,10							2,00												
E071 ENVIRONMENTAL PROTECTION																				
E0711 allocating protection status (national park/reserve/etc)	1,10								2,10	2,20										
E0712 implement environmental protection measures/procedures				1,11	1,73	1,81														
				1,16		1,82														
E0713 licensing interventions with environmental resources	1,40																			
E072 RESTORATION OF ECO-SYSTEMS	1,10	1,80		1,42	1,73															4,20
E073 PROTECTING/MAINTAINING BIO-DIVERSITY	1,10				1,73	1,82								3,34						
E074 RESTORATION OF BIO-DIVERSITY	1,10																			
E075 MAINTAINING ENVIRONMENTAL FLOW				1,11															4,10	4,20
E076 ENVIRONMENTAL IMPACT ASSESSMENT	1,10			1,11												3,22				
E081 DEFINING ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES	1,10							2,00												
E082 COLLECTION OF ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES																				
E0821 collection of taxes/fees/levies/charges for timber and fuel wood harvesting				1,61	1,78															
E0822 collection of taxes/fees/levies/charges for waste disposal	1,10																			
E0823 collection of taxes/fees/levies/charges for game resource use hunting and trappi	1,10			1,61		1,85														
E0824 collection of taxes/fees/levies/charges for natural flora use	1,10				1,73	1,85														
E091 ENVIRONMENTAL RISK ASSESSMENT																				
E0911 assessment/monitoring of pollution (risks)	1,10			1,03	1,71									3,33						
				1,11	1,73															
				1,14																

STATE DISENGAGEMENT as per 2021

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
E041 ASSESSMENT/MONITORING OF NEEDS FOR ENVIRONMENTAL SERVICES	1,10				1,73									3,32						4,20
														3,33						
														3,36						
E042 ENVIRONMENTAL NEEDS FORECASTING	1,10													3,36					4,10	
														3,38						4,20
E051 PLANNING AND BUDGETING FOR ENVIRONMENTAL MANAGEMENT																				
E0511 develop environmental (management) scenarios and/or options	1,10			1,11			1,15												4,10	
E0512 carry out/commission environmental (management) surveys/research	1,10																			
E0513 approval of environmental (management) study results	1,10																			
E0514 public consultations on environmental (management)	1,10			1,11																
E0515 select and approve environmental (management) plans and budgets	1,10																			
E0516 fund/resource reservation for environmental (management)	1,10	1,80																		4,20
	1,40																			
E052 DESIGN OF ENVIRONMENTAL MANAGEMENT INTERVENTIONS																				
E0521 design of environmental (management) measures/procedures	1,10			1,11															4,10	4,20
E0522 approve environmental (management) designs/measures/procedures	1,10																			
E061 LICENSING ENVIRONMENT USE																				
E0611 licensing timber and fuel wood harvesting	1,10				1,73															
E0612 licensing waste disposal in eco-system																				
E0613 licensing game resource use hunting and trapping																				
E0614 licensing natural flora use					1,73															
E062 CERTIFICATION OF ENVIRONMENTAL PROFESSIONALS	1,10																			
E063 ENVIRONMENTAL (MANAGEMENT) CONFLICT RESOLUTION	1,10							2,00												
E071 ENVIRONMENTAL PROTECTION																				
E0711 allocating protection status (national park/reserve/etc)	1,10								2,10	2,20										
E0712 implement environmental protection measures/procedures				1,11	1,73	1,81														
				1,16		1,82														
E0713 licensing interventions with environmental resources	1,40																			
E072 RESTORATION OF ECO-SYSTEMS	1,10	1,80		1,42	1,73															4,20
E073 PROTECTING/MAINTAINING BIO-DIVERSITY	1,10				1,73	1,82								3,34						
E074 RESTORATION OF BIO-DIVERSITY	1,10																			
E075 MAINTAINING ENVIRONMENTAL FLOW				1,11															4,10	4,20
E076 ENVIRONMENTAL IMPACT ASSESSMENT	1,10			1,11												3,22				
E081 DEFINING ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES	1,10							2,00												
E082 COLLECTION OF ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES																				
E0821 collection of taxes/fees/levies/charges for timber and fuel wood harvesting				1,61	1,78															
E0822 collection of taxes/fees/levies/charges for waste disposal	1,10																			
E0823 collection of taxes/fees/levies/charges for game resource use hunting and trappi	1,10			1,61		1,85														
E0824 collection of taxes/fees/levies/charges for natural flora use	1,10				1,73	1,85														
E091 ENVIRONMENTAL RISK ASSESSMENT																				
E0911 assessment/monitoring of pollution (risks)	1,10			1,03	1,71									3,33						
				1,11	1,73															
				1,14																

2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

State Disengagement from Environmental Management Functions (related to water management)
Present Situation and Desired Situations as per 2015 and as per 2021

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Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
E0912 assessment/monitoring of fires (risk)	1,10			1,12	1,72									3,33						
					1,73															
E0913 assessment/monitoring of pests/diseases (risks)	1,10			1,12	1,73									3,33						
E0914 assessment/monitoring of unsustainable use (risks)	1,10			1,11	1,73									3,33						
				1,12																
E092 ENVIRONMENT-RELATED RISK REDUCTION/PREVENTION																				
E0921 pollution risks reducing measures				1,02	1,71	1,82								3,34						
				1,11	1,72															
					1,73															
					1,77															
E0922 fire risks reducing measures	1,10	1,80	1,70	1,12	1,72															
					1,73															
E0923 pests/diseases risks reducing measures	1,10			1,12										3,34	3,40					
	1,30																			
E0924 unsustainable use risks reducing measures	1,10				1,73	1,82								3,34	3,40					
E093 ENVIRONMENT-RELATED IMPACT ALLEVIATION																				
E0931 pollution impact alleviation	1,10													3,34	3,40					
E0932 unsustainable use impact alleviation	1,10			1,12										3,34	3,40					
E101 MANAGEMENT OF INFORMATION ON ENVIRONMENT FOR PROFESSIONAL USE	1,10			1,03	1,71	1,81	1,15							3,31		3,22			4,10	4,20
				1,11	1,73	1,82								3,32						
				1,12	1,74									3,36						
				1,13										3,38						
				1,14																
				1,16																
E102 MANAGEMENT OF ENVIRONMENT INFORMATION FOR PUBLIC USE	1,10			1,03	1,73	1,82	1,15							3,31	3,40				4,10	4,20
				1,11	1,74									3,32	3,41					
				1,12										3,33						
				1,13										3,34						
				1,14										3,35						
				1,16																

STATE DISENGAGEMENT as per 2021

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
E0912 assessment/monitoring of fires (risk)	1,10			1,12	1,72									3,33						
					1,73															
E0913 assessment/monitoring of pests/diseases (risks)	1,10			1,12	1,73									3,33						
E0914 assessment/monitoring of unsustainable use (risks)	1,10			1,11	1,73									3,33						
				1,12																
E092 ENVIRONMENT-RELATED RISK REDUCTION/PREVENTION																				
E0921 pollution risks reducing measures				1,02	1,71	1,82								3,34						
				1,11	1,72															
					1,73															
					1,77															
E0922 fire risks reducing measures	1,10	1,80	1,70	1,12	1,72															
					1,73															
E0923 pests/diseases risks reducing measures	1,10			1,12										3,34	3,40					
	1,30																			
E0924 unsustainable use risks reducing measures	1,10				1,73	1,82								3,34	3,40					
E093 ENVIRONMENT-RELATED IMPACT ALLEVIATION																				
E0931 pollution impact alleviation	1,10													3,34	3,40					
E0932 unsustainable use impact alleviation	1,10			1,12										3,34	3,40					
E101 MANAGEMENT OF INFORMATION ON ENVIRONMENT FOR PROFESSIONAL USE	1,10			1,03	1,71	1,81	1,15							3,31		3,22			4,10	4,20
				1,11	1,73	1,82								3,32						
				1,12	1,74									3,36						
				1,13										3,38						
				1,14																
				1,16																
E102 MANAGEMENT OF ENVIRONMENT INFORMATION FOR PUBLIC USE	1,10			1,03	1,73	1,82	1,15							3,31	3,40				4,10	4,20
				1,11	1,74									3,32	3,41					
				1,12										3,33						
				1,13										3,34						
				1,14										3,35						
				1,16																

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State Disengagement from Land Management Functions (related to water management)
Present Situation and Desired Situation as per 2015 and as per 2021

Color legend for Actor-code:
3,32: regular
4,20: ad hoc / irregular
4,10: undefined

Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
L011 LAND POLICIES AND STRATEGY INTITIATION AND DEVELOPMENT																				
L0111 public consultation for developing land policies/strategies			1,70					2,00	2,10	2,20				3,32						
L0112 commission preparatory studies for developing land policies/strategies	1,20																			
	1,30																			
	1,40																			
L0113 prepare major land development plans/investments	1,10																			
	1,20																			
	1,30																			
	1,40																			
L0114 prepare budgets/resources/cost recovery/subsidies for land development	1,10																			
	1,20																			
	1,30																			
	1,40																			
L0115 prepare institutional development of land sector	1,10																			
	1,20																			
	1,30																			
	1,40																			
L012 LAND POLICY DECISION-TAKING																				
L0121 decide on major land development plans/investments									2,10											
L0122 allocate budgets/resources for land development								2,00	2,10	2,20										
L0123 decide on financing (sources/cost recovery/subsidies) for land development	1,00							2,00	2,10	2,20										
L0124 decide on institutional development of land sector	1,00							2,00												
L013 MONITORING LAND POLICY IMPLEMENTATION/PERFORMANCE				1,21	1,71	1,83		2,00	2,10	2,20				3,32						
					1,75															
L014 COORDINATION OF LAND MANAGEMENT POLICIES																				
L0141 coordination between land (management) projects and/or policies	1,00		1,70																	
	1,20																			
	1,60																			
L0142 coordination between national and local level land policies	1,00		1,70																	
L021 LAND LAW MAKING																				
L0211 develop land laws	1,10			1,21																
	1,20																			
L0212 develop land norms and regulations	1,10			1,21																
	1,20																			
L0213 approve and promulgate land laws								2,00												
L0214 approve land norms and regulations	1,10																			
	1,20																			
L022 INSPECTION AND ENFORCEMENT																				
L0221 inspection on land resources protection	1,10	1,90		1,03	1,71	1,82														
					1,73	1,83														
					1,75															
L0222 imposing corrective/punitive measures on transgressors of land laws				1,03	1,71	1,81														
L051 SPATIAL PLANNING AND LAND USE ALLOCATION	1,10			1,16				2,00		2,20										

STATE DISENGAGEMENT as per 2021

Functions	State							Elected Bodies			Civil Society							IWRM Bodies		
	Public Administration (Central)	Public Administration (Regional)	Public Administration (Local)	Gov. (Technical) Departments (Central)	Gov. (Technical) Departments (Regional)	Gov. (Technical) Departments (Local)	Research Institutes and Universities	Elected Representative Bodies (Central)	Elected Representative Bodies (Regional)	Elected Representative Bodies (Local)	International Environment Institutions	International Financing Institutions	International Research Institutions	NGOs (National)	NGOs (Local)	Private Companies	Programs and (large) Projects	IWRM Organisations (Central)	IWRM Organisations (Basin)	IWRM Organisations (Sub-Basin)
L011 LAND POLICIES AND STRATEGY INTITIATION AND DEVELOPMENT																				
L0111 public consultation for developing land policies/strategies			1,70					2,00	2,10	2,20				3,32						
L0112 commission preparatory studies for developing land policies/strategies	1,20																			
	1,30																			
	1,40																			
L0113 prepare major land development plans/investments	1,10																			
	1,20																			
	1,30																			
	1,40																			
L0114 prepare budgets/resources/cost recovery/subsidies for land development	1,10																			
	1,20																			
	1,30																			
	1,40																			
L0115 prepare institutional development of land sector	1,10																			
	1,20																			
	1,30																			
	1,40																			
L012 LAND POLICY DECISION-TAKING																				
L0121 decide on major land development plans/investments									2,10											
L0122 allocate budgets/resources for land development								2,00	2,10	2,20										
L0123 decide on financing (sources/cost recovery/subsidies) for land development	1,00							2,00	2,10	2,20										
L0124 decide on institutional development of land sector	1,00							2,00												
L013 MONITORING LAND POLICY IMPLEMENTATION/PERFORMANCE				1,21	1,71	1,83		2,00	2,10	2,20				3,32						
					1,75															
L014 COORDINATION OF LAND MANAGEMENT POLICIES																				
L0141 coordination between land (management) projects and/or policies	1,00		1,70																	
	1,20																			
	1,60																			
L0142 coordination between national and local level land policies	1,00		1,70																	
L021 LAND LAW MAKING																				
L0211 develop land laws	1,10			1,21																
	1,20																			
L0212 develop land norms and regulations	1,10			1,21																
	1,20																			
L0213 approve and promulgate land laws								2,00												
L0214 approve land norms and regulations	1,10																			
	1,20																			
L022 INSPECTION AND ENFORCEMENT																				
L0221 inspection on land resources protection	1,10	1,90		1,03	1,71	1,82														
					1,73	1,83														
					1,75															
L0222 imposing corrective/punitive measures on transgressors of land laws				1,03	1,71	1,81														
L051 SPATIAL PLANNING AND LAND USE ALLOCATION	1,10			1,16				2,00		2,20										

Code	Actor_name
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia

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State Disengagement from Land Management Functions (related to water management)
Present Situation and Desired Situation as per 2015 and as per 2021

Color legend for Actor-code:
3,32: regular
4,20: ad hoc / irregular
4,10: undefined

Actor Families and Actor Categories

STATE DISENGAGEMENT as per 2015

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
L071 LAND DEGREDATION/SOIL EROSION PROTECTION																				
L0711 implement land/soil protection measures/procedures				1,12	1,76	1,84														
L0712 land restoration measures	1,10			1,12	1,71	1,81														
				1,16	1,73	1,82														
				1,42																
L081 DEFINING LAND TAXES/FEES/LEVIES/CHARGES					1,75			2,00												
L082 COLLECTION OF LAND TAXES/FEES/LEVIES/CHARGES					1,78	1,85														
				1,61																
L091 LAND USE RELATED RISK ASSESSMENT																				
L0911 assessment/monitoring of fertilizer/pesticide use (risks)	1,30				1,76	1,84														
L0912 assessment/monitoring of pests/diseases (risks)	1,10			1,12	1,76	1,84														
	1,30																			
L092 LAND-RELATED RISK REDUCTION/PREVENTION																				
L0921 risks reducing measures for fertilizer/pesticide use	1,30				1,76	1,84														
L0922 pests/diseases risks reducing measures	1,10			1,12	1,76	1,84														
	1,30																			

STATE DISENGAGEMENT as per 2021

Functions	State: Public Administration (Central)	State: Public Administration (Regional)	State: Public Administration (Local)	State: Gov. (Technical) Departments (Central)	State: Gov. (Technical) Departments (Regional)	State: Gov. (Technical) Departments (Local)	State: Research Institutes and Universities	Elected Bodies: Elected Representative Bodies (Central)	Elected Bodies: Elected Representative Bodies (Regional)	Elected Bodies: Elected Representative Bodies (Local)	Civil Society: International Environment Institutions	Civil Society: International Financing Institutions	Civil Society: International Research Institutions	Civil Society: NGOs (National)	Civil Society: NGOs (Local)	Civil Society: Private Companies	Civil Society: Programs and (large) Projects	IWRM Bodies: IWRM Organisations (Central)	IWRM Bodies: IWRM Organisations (Basin)	IWRM Bodies: IWRM Organisations (Sub-Basin)
L071 LAND DEGREDATION/SOIL EROSION PROTECTION																				
L0711 implement land/soil protection measures/procedures				1,12	1,76	1,84														
L0712 land restoration measures	1,10			1,12	1,71	1,81														
				1,16	1,73	1,82														
				1,42																
L081 DEFINING LAND TAXES/FEES/LEVIES/CHARGES					1,75			2,00												
L082 COLLECTION OF LAND TAXES/FEES/LEVIES/CHARGES					1,78	1,85														
				1,61																
L091 LAND USE RELATED RISK ASSESSMENT																				
L0911 assessment/monitoring of fertilizer/pesticide use (risks)	1,30				1,76	1,84														
L0912 assessment/monitoring of pests/diseases (risks)	1,10			1,12	1,76	1,84														
	1,30																			
L092 LAND-RELATED RISK REDUCTION/PREVENTION																				
L0921 risks reducing measures for fertilizer/pesticide use	1,30				1,76	1,84														
L0922 pests/diseases risks reducing measures	1,10			1,12	1,76	1,84														
	1,30																			

2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp.
3,02	Housing Services Comp. (OCHAAK)
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,37	Nat. level NGOs Legisl. & Policy Renewal
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Annex 5: MIMAT output; Function Dispersion Matrices

The function dispersion matrices for water management, land management and environmental management functions show which actors are responsible for each of the management functions and for which particular 'use'. This allows for an analysis of overlaps and gaps in the functions carried out.

The function dispersion matrices also include the outcome of the performance assessments made for each function an actor carries out. Besides the performance also three potential constraints are assessed that may explain the assessed performance level. These include:

- the human resources available for performing that function
- the competences of the human resources for performing that function
- the available material and financial resources available to perform that function

The assessment score is the result of the actor's own assessment combined with the expert's opinion of the interviewer and complemented with the information obtained from the structured interviews with key actors.

Ratings are given on a qualitative scale: 'Excellent', 'Acceptable', and 'Weak'. Cases where information was lacking the rating 'Undefined' is given. For some functions no actor could be identified.

Assessment of the Dispersion and Performance of Water Management Functions (as per 2010)

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Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excelent
- acceptable
- weak

Assessment: Performance / Number of Human Resources / Competence of Human Resources / Material & Financial Resources

Uses: W11 urban drinking water; W12 semi-urban drinking water; W13 rural drinking water; W21 rain fed crop production; W22 crop irrigation; W23 livestock watering; W24 pasture irrigation (hay making); W31 mining exploitation; W32 food & light industries; W33 thermo-power plants & heating system; W41 hydro-electricity; W42 navigation; W51 flood protection; W52 storm water drainage; W61 tourist camps; W62 fishery and hunting; W63 spa/health resorts; W71 wetlands conservation; W72 environmental flow; W81 urban waste water disposal; W82 industrial waste water disposal

Functions	W11	W12	W13	W21	W22	W23	W24	W31	W32	W33	W41	W42	W51	W52	W61	W62	W63	W71	W72	W81	W82
W011 WATER POLICIES AND STRATEGY INITIATION AND DEVELOPMENT																					
W0111 public consultation for developing water policies/strategies	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0112 commission preparatory studies for developing water policies/strategies	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,20	1,20											1,20	1,20						1,20	1,20
			1,30	1,30	1,30	1,30	1,30		1,30												
								1,40		1,40	1,40										
										1,41	1,41										
	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50	1,50
	1,75												1,75	1,75						1,75	1,75
	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0113 prepare major water development plans/investments	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,20	1,20											1,20	1,20						1,20	1,20
			1,30	1,30	1,30	1,30	1,30		1,30												
								1,40		1,40	1,40										
										1,41	1,41										
	1,75																				
	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10
W0114 prepare budgets/resources/cost recovery/subsidies for water development	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,20	1,20											1,20	1,20						1,20	1,20
			1,30	1,30	1,30	1,30	1,30		1,30												
								1,40		1,40	1,40										
										1,41	1,41										
	1,75												1,75	1,75						1,75	1,75
W0115 prepare institutional development of water sector	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01
																		1,10	1,10		
	1,20	1,20																		1,20	1,20
W012 WATER POLICY DECISION-TAKING																					
W0121 decide on major water development plans/investments	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
W0122 allocate budgets/resources for water development	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
W0123 decide on financing (sources/cost recovery/subsidies) for water development	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
W0124 decide on institutional development of water sector	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
W013 MONITORING WATER POLICY IMPLEMENTATION/PERFORMANCE	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W014 WATER (MANAGEMENT) POLICY COORDINATION	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
W0141 international coordination on water resources	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W0142 coordination between water projects and/or policies	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01	1,01
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60
	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0143 coordination between national and local level water policies	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
W021 WATER LAW MAKING																					
W0211 developing water laws	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,20	1,20											1,20	1,20						1,20	1,20
			1,30	1,30	1,30	1,30	1,30		1,30												
								1,40		1,40	1,40										
	1,50	1,50	1,50														1,50				
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
W0212 developing water norms and regulations																				1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20
	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21
				1,30	1,30	1,30	1,30														
																				1,50	1,50
																				1,51	1,51
W0213 developing water standards																				1,05	1,05
																				1,10	1,10
																				1,20	1,20
																					1,30
																				1,50	1,50
W0214 approve and promulgate water laws	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Water Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies
- (black)

Assessment color-code:
- (green) excelent
- (yellow) acceptable
- (red) weak
- (grey)

Functions	Performance	Number of Human Resources	Competence of Human Resources	Matarial & Financial Resources	W11 urban drinking water	W12 semi-urban drinking water	W13 rural drinking water	W21 rain fed crop production	W22 crop irrigation	W23 livestock watering	W24 pasture irrigation (hay making)	W31 mining exploitation	W32 food & light industries	W33 thermo-power plants & heating system	W41 hydro-electricity	W42 navigation	W51 flood protection	W52 storm water drainage	W61 tourist camps	W62 fishery and hunting	W63 spa/health resorts	W71 wetlands conservation	W72 environmental flow	W81 urban waste water disposal	W82 industrial waste water disposal
W0215 approve water norms and regulations	red	yellow	yellow	yellow	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	yellow	yellow	yellow	yellow	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20
	yellow	yellow	yellow	yellow				1,30	1,30	1,30	1,30														
	yellow	yellow	yellow	yellow	1,50	1,50	1,50																	1,50	1,50
	yellow	yellow	yellow	yellow	1,51	1,51	1,51																		
W0216 approve water standards	yellow	yellow	green	yellow	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05
W022 INSPECTION AND ENFORCEMENT																									
W0221 inspection on water resource utilization	red	red	red	grey	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	red	red	red	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	red	red	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	yellow	yellow	yellow	yellow	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0222 inspection on water resource protection	red	yellow	red	grey	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	red	yellow	red	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	red	red	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	yellow	yellow	yellow	yellow	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0223 approve implementation of water works/measures	red	yellow	red	grey	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W0224 approve operation and maintenance of water infrastructure	black	black	black	black	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
W0225 imposing corrective/punitive measures on transgressors of water laws	red	red	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	yellow	yellow	yellow	yellow	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W031 QUANTITATIVE WATER RESOURCES ASSESSMENT/MONITORING	red	yellow	grey	yellow	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W0311 assessment/monitoring of meteoric water	yellow	yellow	yellow	yellow				1,15	1,15	1,15	1,15				1,15		1,15	1,15				1,15	1,15		
W0312 assessment/monitoring of surface water	red	red	red	grey					1,11			1,11			1,11		1,11					1,11	1,11		
	yellow	yellow	yellow	yellow				1,15	1,15	1,15	1,15				1,15		1,15					1,15	1,15		
	yellow	yellow	yellow	yellow	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	yellow	yellow	yellow	yellow	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74
	yellow	yellow	yellow	red	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82
W0313 assessment/monitoring of ground water	yellow	yellow	green	yellow	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	yellow	grey	yellow	yellow	1,11	1,11	1,11		1,11			1,11	1,11	1,11					1,11						
	yellow	yellow	yellow	yellow								1,42													
	yellow	yellow	yellow	yellow	3,01																				
	red	red	yellow	yellow	3,03	3,03																			
W0314 assessment/monitoring of springs	yellow	grey	grey	grey															1,11						
	yellow	yellow	yellow	yellow								1,42													
	yellow	yellow	yellow	yellow																	1,51				
W0315 assessment/monitoring of glaciers	yellow	yellow	yellow	red	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
W032 QUALITATIVE WATER RESOURCES ASSESSMENT/MONITORING	yellow	yellow	grey	yellow	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W0321 assessment/monitoring of surface water - quality	yellow	yellow	yellow	yellow	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03
	yellow	yellow	green	yellow	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04
	yellow	yellow	green	yellow	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	yellow	yellow	red	red																			1,11	1,11	1,11
	yellow	green	green	yellow	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14
	yellow	yellow	yellow	yellow	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
W0322 assessment/monitoring of ground water - quality	yellow	yellow	yellow	yellow	1,03	1,03	1,03					1,03	1,03	1,03					1,03	1,03	1,03				
	yellow	yellow	green	yellow	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04
	yellow	yellow	green	yellow	1,06	1,06	1,06					1,06	1,06	1,06					1,06	1,06	1,06			1,06	1,06
	red	yellow	yellow	yellow	1,11	1,11	1,11					1,11	1,11	1,11					1,11	1,11	1,11			1,11	1,11
	red	yellow	yellow	yellow	3,01																				
	yellow	red	red	red	3,03	3,03																			
W033 WATER (MANAGEMENT) ASSESSMENT AND MONITORING	yellow	yellow	green	yellow	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	red	grey	grey	grey	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W0331 water (management) impact assessment	red	red	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
W0332 assessment/monitoring of resource protection	yellow	yellow	yellow	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	red	red	yellow	red	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
	yellow	red	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	yellow	red	yellow	yellow	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0333 assessment/monitoring of permafrost	red	yellow	yellow	red	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
W041 WATER DEMAND ASSESSMENT/MONITORING	yellow	green	yellow	yellow													1,02								
	yellow	yellow	green	yellow	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	red	grey	grey	grey	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	red	red	red	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	red	yellow	grey	grey	1,21	1,21																			
	yellow	yellow	yellow	yellow			1,30																		
	yellow	yellow	yellow	yellow										1,41	1,41										
	yellow	yellow	yellow	yellow								1,42													
	yellow	yellow	yellow	red													1,70	1,70							
	red	red	red	grey																				1,80	1,80
W042 WATER DEMAND FORECASTING	red	grey	grey	grey	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	red	red	red	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	yellow	yellow	yellow	red	1,20	1,20																		1,20	1,20
	yellow	yellow	yellow	yellow			1,30	1,30	1,30	1,30	1,30														
	yellow	yellow	yellow	yellow										1,41	1,41										
	yellow	yellow	yellow	yellow								1,42													
W051 PLANNING AND BUDGETTING FOR WATER MANAGEMENT																									
W0511 develop water (management) scenario's and/or options	yellow	grey	red	red	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	red	yellow	red	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	yellow	yellow	yellow	yellow	1,20	1,20																		1,20	1,20
	yellow	yellow	yellow	yellow				1,30	1,30	1,30	1,30														
	yellow	yellow	yellow	yellow										1,41	1,41										
	yellow	yellow	yellow	yellow								1,42													
	red	red	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
W0512 carry out/commission water (management) surveys/research	yellow	yellow	green	yellow	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	yellow	yellow	yellow	red	1,11	1,11	1,11					1,11	1,11	1,11								1,11	1,11		
	yellow	yellow	yellow	yellow			1,30																		
	yellow	yellow	yellow	yellow										1,40	1,40										
	yellow	yellow	yellow	yellow								1,42													

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Water Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excellent
- acceptable
- weak

Assessment: Performance, Number of Human Resources, Competence of Human Resources, Matarial & Financial Resources

Functions	W11 urban drinking water	W12 semi-urban drinking water	W13 rural drinking water	W21 rain fed crop production	W22 crop irrigation	W23 livestock watering	W24 pasture irrigation (hay making)	W31 mining exploitation	W32 food & light industries	W33 thermo-power plants & heating system	W41 hydro-electricity	W42 navigation	W51 flood protection	W52 storm water drainage	W61 tourist camps	W62 fishery and hunting	W63 spa/health resorts	W71 wetlands conservation	W72 environmental flow	W81 urban waste water disposal	W82 industrial waste water disposal
W0513 approval of water (management) study results	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11					1,11	1,11	1,11								1,11	1,11		
	1,20	1,20																		1,20	1,20
			1,30	1,30	1,30	1,30	1,30														
										1,40	1,40										
W0514 prospecting groundwater resources	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
								1,42													
	3,21	3,21	3,21					3,21													
W0515 public consultations on water (management)	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0516 select and approve water (management) plans and budgets	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
																		1,10	1,10		
	1,20	1,20																		1,20	1,20
			1,30	1,30	1,30	1,30	1,30														
										1,40	1,40										
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
W0517 fund/resource reservation for water (management)	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,20	1,20																		1,20	1,20
			1,30	1,30	1,30	1,30	1,30														
										1,40	1,40										
W052 DESIGN OF WATER MANAGEMENT INTERVENTIONS																					
W0521 design of water (management) measures/procedures	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
W0522 design of water (management) infrastructure	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	1,21	1,21											1,21	1,21						1,21	1,21
			1,30		1,30	1,30															
										1,41	1,41										
W0523 approve water (management) designs/measures/procedures	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21	1,21
W061 LICENSING WATER USE																					
W0611 licensing withdrawal/abstraction of surface water	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W0612 licensing withdrawal/abstraction of ground water	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
		1,80		1,80	1,80	1,80	1,80	1,80	1,80	1,80					1,80						
W0613 licensing trading in water	1,20	1,20																			
		1,80																			
W062 LICENSING DISPOSAL ON WATER SYSTEM																					
W0621 licensing disposal of wastewater on water system																				0,00	0,00
W0622 licensing disposal of waste on water system																				0,00	0,00
W0623 licensing disposal of heat on water system																				0,00	0,00
W063 LICENSING CONSTRUCTION/INTERVENTIONS IN WATER SYSTEM																					
W0631 licensing constructions within the water system											0,00	0,00									
W0632 licensing interferences in the water system	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
W064 LICENSING TRANSPORTATION OF WATER	1,20	1,20																			
		1,80																			
W065 CERTIFICATION OF WATER PROFESSIONALS	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20
W066 RESOLVING WATER (MANAGEMENT) CONFLICTS	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W071 WATER SUPPLY MANAGEMENT																					
W0711 supply of raw water	3,21	3,21	3,21					3,21													
W0712 water treatment (drinking water)		1,80																			
	3,01																				
	3,03	3,03																			
	3,21	3,21	3,21																		
	3,23	3,23																			
W0713 distribution of treated water	3,01																				
	3,02																				
	3,03	3,03																			
	3,21	3,21	3,21																		
	3,23	3,23																			
W072 WASTE WATER MANAGEMENT																					
W0721 evacuation of waste water																				3,01	
																				3,02	
																				3,03	3,03
																				3,21	3,21
																					3,24
																				3,25	3,25
W0722 treatment of waste water																				3,01	
																				3,03	3,03
																					3,21
																					3,24
																				3,25	3,25
W073 STORM WATER MANAGEMENT																					
W0731 evacuation of storm water														1,70							
														1,80							
W0732 flood protection													1,70								
													1,80								
W074 PROTECTION OF WATER RESOURCES																					
W0741 implement water resources protection measures/procedures	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W0742 licensing interventions with water resource	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Water Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excelent
- acceptable
- weak

Assessment: Performance; Number of Human Resources; Competence of Human Resources; Material & Financial Resources

Uses

Functions	W11 urban drinking water	W12 semi-urban drinking water	W13 rural drinking water	W21 rain fed crop production	W22 crop irrigation	W23 livestock watering	W24 pasture irrigation (hay making)	W31 mining exploitation	W32 food & light industries	W33 thermo-power plants & heating system	W41 hydro-electricity	W42 navigation	W51 flood protection	W52 storm water drainage	W61 tourist camps	W62 fishery and hunting	W63 spa/health resorts	W71 wetlands conservation	W72 environmental flow	W81 urban waste water disposal	W82 industrial waste water disposal
W0743 water resources restoration measures	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
																		1,12	1,12		
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W076 WATER SERVICES INFRASTRUCTURE	3,21	3,21	3,21					3,21													
W0761 construction (supervision) of water services infrastructure										1,41	1,41										
		1,75											1,75	1,75						1,75	
					1,76	1,76															
			1,80			1,80							1,80	1,80							
	3,01																			3,01	
	3,03	3,03																		3,03	3,03
	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10
	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
W0762 operation and maintenance of water services infrastructure										1,41	1,41										
													1,70	1,70							
			1,80			1,80							1,80	1,80							
	3,01																			3,01	
	3,02																				
	3,03	3,03																		3,03	3,03
	3,23	3,23																			
																					3,24
																				3,25	3,25
W081 DEFINING WATER (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES															1,80						
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10																				
		2,20																			
	3,21	3,21	3,21																	3,21	
W082 COLLECTION OF WATER (MANAGEMENT) TAX/FEE/LEVIES/CHARGES																					
W0821 collection of tax/fee/levies/charges for withdrawal/use of water	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61
	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78
W0822 collection of tax/fee/levies/charges for disposal of waste water/waste/heat																				0,00	0,00
W0823 collection of tax/fee/levies/charges for interference with water management system	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03
W0824 collection of tax/fee/levies/charges for water transportation	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61
	3,01																				
	3,02																				
	3,03	3,03																		3,03	3,03
		3,21																			
	3,23	3,23																			
W0825 collection of tax/fee/levies/charges for water trading	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61
	3,01																				
																				3,02	3,02
	3,03	3,03	3,03																		
																				3,21	
																				3,24	
																				3,25	3,25
W091 WATER-RELATED RISK ASSESSMENT	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
W0911 assessment/monitoring of flood (risks)	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
													1,70	1,70							
													1,80	1,80							
W0912 assessment/monitoring of drought (risks)	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
				1,13	1,13	1,13	1,13														
											1,41										
				1,70	1,70	1,70	1,70														
				1,80	1,80	1,80	1,80														
W0913 assessment/monitoring of water-related health (risks)																	1,50			1,50	1,50
																				1,51	1,51
																				1,77	1,77
W092 WATER-RELATED RISK REDUCTION/PREVENTION	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
W0921 flood risks reducing measures													1,02								
													1,70								
													1,72								
													1,80								
W0922 drought risks reducing measures	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
						1,30															
				1,70	1,70	1,70	1,70														
				1,80	1,80	1,80	1,80														
W0923 water-related health risks reducing measures	1,50	1,50	1,50														1,50			1,50	1,50
W093 WATER-RELATED IMPACT ALLEVIATION	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
W0931 flood impact alleviation													1,02	1,02							
													1,70	1,70							
													1,72								
													1,80								
W0932 drought impact alleviation	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
				1,30	1,30	1,30	1,30														
				1,70	1,70	1,70	1,70														
				1,72	1,72	1,72	1,72														
				1,80	1,80	1,80	1,80														
W0933 water-related health impact alleviation																				0,00	0,00

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Water Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excellent (green)
- acceptable (yellow)
- weak (red)
- (grey)

W101 MANAGEMENT OF INFORMATION ON WATER FOR PROFESSIONAL USE

Functions	Performance	Number of Human Resources	Competence of Human Resources	Material & Financial Resources	W11 urban drinking water	W12 semi-urban drinking water	W13 rural drinking water	W21 rain fed crop production	W22 crop irrigation	W23 livestock watering	W24 pasture irrigation (hay making)	W31 mining exploitation	W32 food & light industries	W33 thermo-power plants & heating system	W41 hydro-electricity	W42 navigation	W51 flood protection	W52 storm water drainage	W61 tourist camps	W62 fishery and hunting	W63 spa/health resorts	W71 wetlands conservation	W72 environmental flow	W81 urban waste water disposal	W82 industrial waste water disposal
W1011 water (management) data collection	acceptable	acceptable	acceptable	acceptable	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04
	acceptable	acceptable	excellent	acceptable	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	weak	weak	weak	weak	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	acceptable	acceptable	acceptable	acceptable	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
	acceptable	acceptable	acceptable	acceptable	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
	acceptable	acceptable	acceptable	acceptable	1,21	1,21																		1,21	1,21
	acceptable	acceptable	acceptable	acceptable				1,30	1,30	1,30	1,30														
	acceptable	acceptable	acceptable	acceptable										1,41	1,41										
	acceptable	acceptable	acceptable	acceptable								1,42													
	acceptable	acceptable	acceptable	acceptable	1,50	1,50	1,50														1,50			1,50	1,50
	acceptable	acceptable	acceptable	acceptable	1,51	1,51	1,51														1,51			1,51	1,51
	acceptable	acceptable	weak	acceptable	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
	acceptable	acceptable	acceptable	acceptable	1,71	1,71	1,71	1,71	1,71	1,71	1,71								1,71	1,71	1,71			1,71	1,71
	weak	acceptable	weak	grey	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	acceptable	acceptable	acceptable	grey	1,75	1,75	1,75										1,75							1,75	1,75
	acceptable	acceptable	grey	acceptable				1,76	1,76	1,76	1,76														
	acceptable	acceptable	weak	acceptable	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
	acceptable	acceptable	acceptable	acceptable	3,01																			3,01	
	acceptable	acceptable	acceptable	acceptable	3,02	3,02	3,02																	3,02	3,02
	weak	weak	weak	weak	3,03	3,03																		3,03	3,03
	acceptable	acceptable	acceptable	acceptable								3,21													
	acceptable	acceptable	excellent	acceptable	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
	acceptable	acceptable	acceptable	acceptable	3,23	3,23																			
	weak	acceptable	weak	weak																					3,24
	acceptable	grey	grey	grey																				3,25	3,25
	acceptable	acceptable	acceptable	acceptable	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	acceptable	acceptable	acceptable	acceptable	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W1012 water (management) data storage	acceptable	acceptable	acceptable	acceptable	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04
	weak	weak	weak	weak	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	acceptable	acceptable	acceptable	acceptable								1,42													
	acceptable	acceptable	excellent	acceptable	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
W1013 water (management) data exchange	weak	acceptable	acceptable	acceptable	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04
	weak	weak	weak	weak	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	acceptable	acceptable	acceptable	acceptable								1,42													
	acceptable	acceptable	acceptable	acceptable	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
W1014 water (management) data analysis	acceptable	acceptable	acceptable	acceptable	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04	1,04
	acceptable	acceptable	excellent	acceptable	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	acceptable	weak	weak	acceptable	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	acceptable	acceptable	acceptable	acceptable	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
	acceptable	acceptable	acceptable	acceptable	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
	acceptable	acceptable	acceptable	acceptable	1,21	1,21	1,21										1,21							1,21	1,21
	acceptable	acceptable	acceptable	acceptable				1,30	1,30	1,30	1,30														
	acceptable	acceptable	acceptable	acceptable										1,41	1,41										
	acceptable	acceptable	acceptable	acceptable								1,42													
	acceptable	acceptable	acceptable	acceptable	1,51	1,51	1,51														1,51			1,51	1,51
	acceptable	acceptable	acceptable	acceptable								3,21													
	acceptable	acceptable	excellent	acceptable	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
	acceptable	acceptable	acceptable	acceptable	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
W1015 water (management) information exchange	acceptable	acceptable	excellent	acceptable	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06
	weak	acceptable	acceptable	acceptable	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	acceptable	acceptable	acceptable	acceptable	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
	acceptable	acceptable	acceptable	acceptable	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
	excellent	excellent	excellent	acceptable	1,21	1,21	1,21										1,21							1,21	1,21
	acceptable	acceptable	acceptable	acceptable				1,30	1,30	1,30	1,30														
	acceptable	acceptable	acceptable	acceptable										1,41	1,41										
	acceptable	acceptable	acceptable	acceptable								1,42													
	acceptable	acceptable	excellent	acceptable	1,51	1,51	1,51														1,51			1,51	1,51
	acceptable	acceptable	acceptable	acceptable								3,21													
	acceptable	acceptable	acceptable	acceptable	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
	acceptable	acceptable	acceptable	acceptable	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Water Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- (green) excelent
- (yellow) acceptable
- (red) weak
- (grey)

W102 MANAGEMENT OF WATER INFORMATION FOR PUBLIC USE

Functions	Performance	Number of Human Resources	Competence of Human Resources	Matarial & Financial Resources	W11 urban drinking water	W12 semi-urban drinking water	W13 rural drinking water	W21 rain fed crop production	W22 crop irrigation	W23 livestock watering	W24 pasture irrigation (hay making)	W31 mining exploitation	W32 food & light industries	W33 thermo-power plants & heating system	W41 hydro-electricity	W42 navigation	W51 flood protection	W52 storm water drainage	W61 tourist camps	W62 fishery and hunting	W63 spa/health resorts	W71 wetlands conservation	W72 environmental flow	W81 urban waste water disposal	W82 industrial waste water disposal
W1021 water (management) information dissemination	yellow	yellow	yellow	yellow	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	red	red	yellow	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	yellow	yellow	yellow	yellow	1,20	1,20	1,20										1,20	1,20						1,20	1,20
	yellow	yellow	yellow	yellow				1,30	1,30	1,30	1,30														
	yellow	yellow	yellow	yellow								1,40		1,40	1,40										
	yellow	yellow	yellow	yellow	1,50	1,50	1,50														1,50			1,50	1,50
	yellow	yellow	green	yellow	1,51	1,51	1,51														1,51			1,51	1,51
	yellow	yellow	red	yellow	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
	yellow	yellow	yellow	yellow	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	yellow	yellow	yellow	yellow																	1,77				
	red	yellow	red	yellow		1,80																		1,80	1,80
	yellow	yellow	yellow	yellow	3,01																			3,01	
	yellow	yellow	yellow	yellow	3,02	3,02	3,02																	3,02	3,02
	yellow	yellow	yellow	red	3,03	3,03																		3,03	3,03
	yellow	yellow	yellow	red	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31
	yellow	grey	grey	grey	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	yellow	grey	grey	red	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35
	yellow	grey	grey	red	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41
	red	yellow	red	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	yellow	yellow	yellow	yellow	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
W1022 public awareness campaigning on water (management)	yellow	yellow	yellow	yellow	1,10	1,10	1,10															1,10	1,10	1,10	1,10
	red	red	yellow	red	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	yellow	yellow	red	yellow	1,20	1,20	1,20										1,20	1,20						1,20	1,20
	yellow	yellow	yellow	yellow										1,40											
	yellow	yellow	yellow	yellow	1,50	1,50	1,50																	1,50	1,50
	yellow	yellow	yellow	yellow	1,51	1,51	1,51																	1,51	1,51
	yellow	yellow	yellow	yellow	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
	yellow	yellow	yellow	yellow	1,77	1,77	1,77																	1,77	1,77
	yellow	yellow	yellow	yellow	3,01																			3,01	
	yellow	yellow	yellow	yellow	3,02	3,02	3,02																	3,02	3,02
	yellow	yellow	yellow	yellow	3,03	3,03																		3,03	3,03
	yellow	yellow	yellow	red	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31
	yellow	grey	grey	grey	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	yellow	grey	grey	red	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35	3,35
	yellow	grey	grey	red	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41
	red	yellow	yellow	red	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	yellow	yellow	yellow	yellow	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
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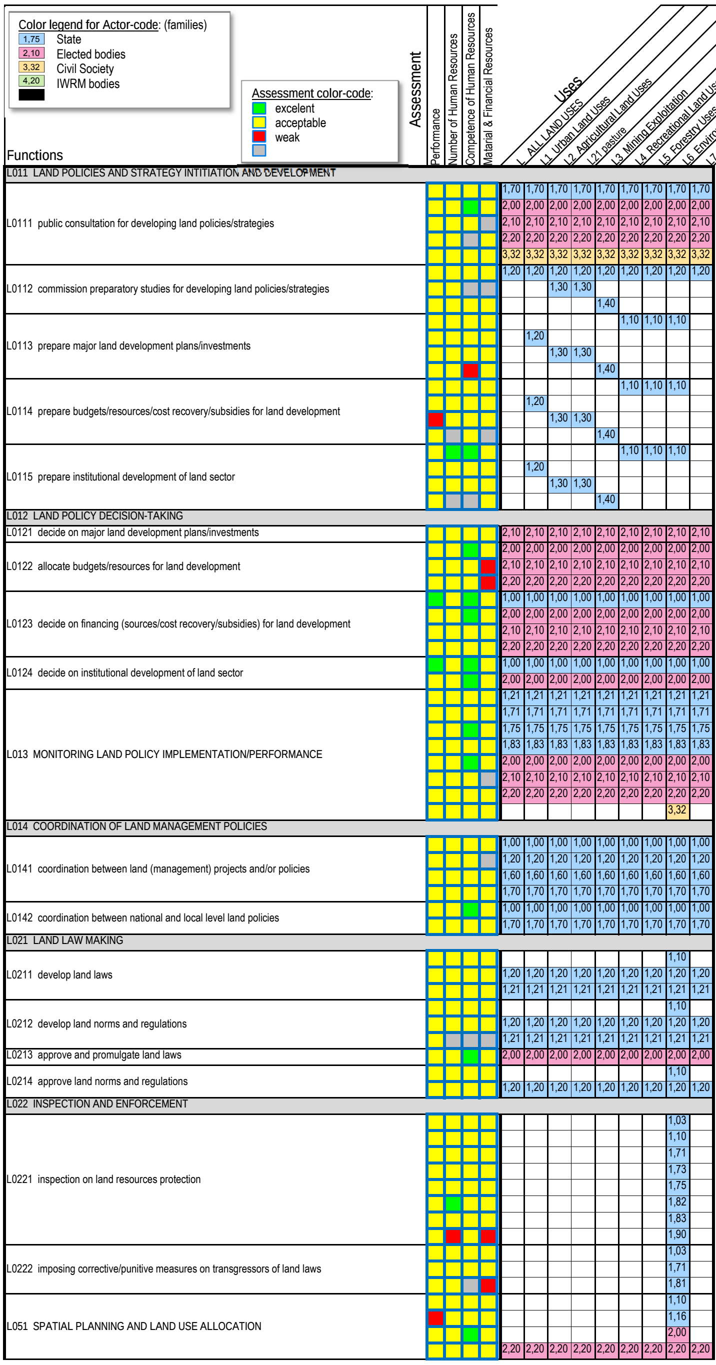
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Land Management Functions (as per 2010)



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1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
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3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Land Management Functions (as per 2010)

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies
- (black)

Assessment color-code:
- excelent (green)
- acceptable (yellow)
- weak (red)
- (grey)

Functions	Performance	Number of Human Resources	Competence of Human Resources	Matarial & Financial Resources	L ALL LAND USES	L1 Urban Land Uses	L2 Agricultural Land Uses	L21 pasture	L3 Mining Exploitation	L4 Recreational Land Uses	L5 Forestry Uses	L6 Environmental Land Uses	L7 Other Land Uses
L071 LAND DEGRADATION/SOIL EROSION PROTECTION													
L0711 implement land/soil protection measures/procedures	yellow	yellow	yellow	grey							1,12		
	yellow	yellow	yellow	red				1,76					
	yellow	red	yellow	grey				1,84					
L0712 land restoration measures	yellow	yellow	yellow	red								1,10	
	red	yellow	yellow	red							1,12		
	red	yellow	yellow	yellow								1,16	
	yellow	yellow	yellow	yellow					1,42				
	red	yellow	grey	red					1,71				
	red	yellow	yellow	red					1,73				
	red	yellow	grey	red					1,81				
	red	yellow	yellow	red					1,82				
L081 DEFINING LAND TAXES/FEES/LEVIES/CHARGES	black	black	black	black	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	yellow	yellow	green	yellow	1,75	1,75	1,75	1,75	1,75	1,75	1,75	1,75	1,75
	yellow	yellow	green	yellow	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
L082 COLLECTION OF LAND TAXES/FEES/LEVIES/CHARGES	black	black	black	black	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	yellow	yellow	yellow	yellow	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61	1,61
	yellow	yellow	yellow	yellow	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78	1,78
	yellow	yellow	yellow	yellow	1,85	1,85	1,85	1,85	1,85	1,85	1,85	1,85	1,85
L091 LAND USE RELATED RISK ASSESSMENT													
L0911 assessment/monitoring of fertilizer/pesticide use (risks)	yellow	yellow	yellow	yellow			1,30	1,30					
	yellow	yellow	yellow	yellow			1,76	1,76					
	yellow	yellow	yellow	yellow			1,84	1,84					
L0912 assessment/monitoring of pests/diseases (risks)	yellow	yellow	yellow	yellow							1,10		
	yellow	yellow	yellow	grey							1,12		
	yellow	yellow	yellow	yellow			1,30	1,30					
	yellow	yellow	yellow	yellow			1,76	1,76					
	yellow	yellow	yellow	yellow			1,84	1,84					
L092 LAND-RELATED RISK REDUCTION/PREVENTION													
L0921 risks reducing measures for fertilizer/pesticide use	yellow	yellow	yellow	yellow			1,30	1,30					
	green	yellow	yellow	yellow			1,76	1,76					
	yellow	red	yellow	red			1,84	1,84					
L0922 pests/diseases risks reducing measures	yellow	yellow	yellow	grey							1,10		
	red	yellow	yellow	red							1,12		
	yellow	yellow	yellow	yellow			1,30	1,30					
	green	yellow	yellow	yellow							1,76		
	yellow	red	yellow	red							1,84		

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Environmental Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excelent
- acceptable
- weak

Assessment: Performance; Number of Human Resources; Competence of Human Resources; Matarial & Financial Resources

Functions	E11 regulating climate	E12 regulating floods	E13 regulating diseases	E14 regulating water quality	E15 regulating water supply	E21 supply of food/fruits	E22 supply of fibers/timber	E23 supply of water	E24 supply of medicinal products	E25 supply of firewood	E31 soil formation	E32 pollination	E33 nutrient cycle	E34 sustaining biodiversity	E41 spiritual services (sacred springs/forests etc)	E42 aesthetical services	E43 Recreational services
E011 ENVIRONMENTAL POLICIES AND STRATEGY INITIATION AND DEVELOPMENT																	
E0111 public consultation for developing environmental policies/strategies	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
E0112 commission preparatory studies for developing environmental policies/strategies	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60
	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E0113 prepare major environmental development plans/investments	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10
E0114 prepare budgets/resources/cost recovery/subsidies for environmental development	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10	3,10
E0115 prepare institutional development of environment sector	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E012 ENVIRONMENTAL POLICY DECISION-TAKING																	
E0121 decide on major environmental development plans/investments	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
FE9 - E0122 allocate budgets/resources for environmental development	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20
E0123 decide on financing (sources/cost recovery/subsidies) for environmental development	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20
E0124 decide on institutional development of environmental sector	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
E013 MONITORING ENVIRONMENTAL POLICY IMPLEMENTATION/PERFORMANCE	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20
	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39	3,39
E014 COORDINATING ENVIRONMENTAL MANAGEMENT POLICIES																	
E0141 international coordination on environmental resources						1,00	1,00	1,00	1,00	1,00							
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E0142 coordination between environmental projects and/or policies	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60	1,60
	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
E0143 coordination between national and local level environmental policies	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70
E021 ENVIRONMENTAL LAW MAKING																	
E0211 developing environmental laws	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E0212 developing environmental norms and regulations	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
				1,11	1,11			1,11									
										1,12							
E0213 developing environmental standards	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
				1,11	1,11			1,11									
										1,12							
E0214 approve and promulgate environmental laws	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
E0215 approve environmental norms and regulations	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E0216 approve environmental standards	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05
E022 INSPECTION AND ENFORCEMENT																	
E0221 inspection on environmental protection	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81
	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82
E0222 approve implementation of environmental restoration/conservation measures	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
E0223 imposing corrective/punitive measures on transgressors of environmental laws	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03
	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81
E031 ASSESSMENT/MONITORING ECO-SYSTEMS	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
										1,12							
	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14
	1,15	1,15															
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E032 ASSESSMENT/MONITORING OF ENVIRONMENTAL PROTECTION	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
										1,12							
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E041 ASSESSMENT/MONITORING OF NEEDS FOR ENVIRONMENTAL SERVICES	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E042 ENVIRONMENTAL NEEDS FORECASTING	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36
	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Environmental Management Functions (as per 2010)

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excelent
- acceptable
- weak

Functions	Performance	Number of Human Resources	Competence of Human Resources	Matarial & Financial Resources	E11 regulating climate	E12 regulating floods	E13 regulating diseases	E14 regulating water quality	E15 regulating water supply	E21 supply of food/fruits	E22 supply of fibers/timber	E23 supply of water	E24 supply of medicinal products	E25 supply of firewood	E31 soil formation	E32 pollination	E33 nutrient cycle	E34 sustaining biodiversity	E41 spiritual services (sacred springs/forests etc)	E42 aesthetical services	E43 Recreational services
E051 PLANNING AND BUDGETING FOR ENVIRONMENTAL MANAGEMENT																					
E0511 develop environmental (management) scenarios and/or options					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
								1,11	1,11			1,11									
					1,15																
					4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
E0512 carry out/commission environmental (management) surveys/research					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E0513 approval of environmental (management) study results					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E0514 public consultations on environmental (management)					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
								1,11	1,11			1,11									
E0515 select and approve environmental (management) plans and budgets					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E0516 fund/resource reservation for environmental (management)					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
					1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
					1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
					4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E052 DESIGN OF ENVIRONMENTAL MANAGEMENT INTERVENTIONS																					
E0521 design of environmental (management) measures/procedures					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
								1,11	1,11			1,11									
					4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
					4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E0522 approve environmental (management) designs/measures/procedures					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E061 LICENSING ENVIRONMENT USE																					
E0611 licensing timber and fuel wood harvesting											1,10			1,10							
														1,73							
E0612 licensing waste disposal in eco-system					0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E0613 licensing game resource use hunting and trapping																		0,00			
E0614 licensing natural flora use										1,73	1,73	1,73	1,73	1,73							
E062 CERTIFICATION OF ENVIRONMENTAL PROFESSIONALS					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E063 ENVIRONMENTAL (MANAGEMENT) CONFLICT RESOLUTION					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
					2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
E071 ENVIRONMENTAL PROTECTION																					
E0711 allocating protection status (national park/reserve/etc)					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
					2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
					2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20	2,20
E0712 implement environmental protection measures/procedures								1,11	1,11			1,11									
															1,16	1,16	1,16	1,16			
					1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
					1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81
					1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82
E0713 licensing interventions with environmental resources					1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
E072 RESTORATION OF ECO-SYSTEMS					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
					1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42	1,42
					1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
					1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
					4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E073 PROTECTING/MAINTAINING BIO-DIVERSITY					1,10	1,10	1,10	1,10	1,10												
					1,73	1,73	1,73	1,73	1,73												
					1,82	1,82	1,82	1,82	1,82												
					3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34
E074 RESTORATION OF BIO-DIVERSITY					1,10	1,10	1,10	1,10	1,10												
E075 MAINTAINING ENVIRONMENTAL FLOW																		1,11			
					4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10							
																		4,20			
E076 ENVIRONMENTAL IMPACT ASSESSMENT					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
								1,11													
					3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
E081 DEFINING ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
										2,00	2,00	2,00	2,00	2,00							
E082 COLLECTION OF ENVIRONMENTAL (MANAGEMENT) TAXES/FEES/LEVIES/CHARGES																					
E0821 collection of taxes/fees/levies/charges for timber and fuel wood harvesting											1,61			1,61							
														1,78							
E0822 collection of taxes/fees/levies/charges for waste disposal					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
E0823 collection of taxes/fees/levies/charges for game resource use hunting and trapping					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
																					1,61
																					1,85
E0824 collection of taxes/fees/levies/charges for natural flora use					1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
										1,73	1,73	1,73	1,73	1,73							
										1,85											
E091 ENVIRONMENTAL RISK ASSESSMENT																					
E0911 assessment/monitoring of pollution (risks)															1,03	1,03	1,03	1,03			
															1,10	1,10	1,10	1,10			
								1,11													
					1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14
															1,71	1,71	1,71	1,71			
															1,73	1,73	1,73	1,73			
					3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
E0912 assessment/monitoring of fires (risk)															1,10	1,10	1,10	1,10			
					1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12
															1,72	1,72	1,72	1,72			
					1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
					3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
E0913 assessment/monitoring of pests/diseases (risks)															1,10	1,10	1,10	1,10			
					1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12
					1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
					3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
E0914 assessment/monitoring of unsustainable use (risks)															1,10	1,10	1,10	1,10			
								1,11	1,11			1,11									
														1,12	1,12	1,12	1,12	1,12			
															1,73	1,73	1,73	1,73			
					3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
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3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
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3,22	Consultants (Companies)
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3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Assessment of the Dispersion and Performance of Environmental Management Functions (as per 2010)

mimat

Color legend for Actor-code: (families)
- 1,75 State
- 2,10 Elected bodies
- 3,32 Civil Society
- 4,20 IWRM bodies

Assessment color-code:
- excelent
- acceptable
- weak

Assessment: Performance, Number of Human Resources, Competence of Human Resources, Material & Financial Resources

Functions	E11 regulating climate	E12 regulating floods	E13 regulating diseases	E14 regulating water quality	E15 regulating water supply	E21 supply of food/fruits	E22 supply of fibers/timber	E23 supply of water	E24 supply of medicinal products	E25 supply of firewood	E31 soil formation	E32 pollination	E33 nutrient cycle	E34 sustaining biodiversity	E41 spiritual services (sacred springs/forests etc)	E42 aesthetical services	E43 Recreational services
E092 ENVIRONMENT-RELATED RISK REDUCTION/PREVENTION																	
E0921 pollution risks reducing measures											1,02	1,02	1,02	1,02			
											1,11	1,11	1,11	1,11			
											1,71	1,71	1,71	1,71			
											1,72	1,72	1,72	1,72			
											1,73	1,73	1,73	1,73			
											1,77	1,77	1,77	1,77			
											1,82	1,82	1,82	1,82			
	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34
E0922 fire risks reducing measures											1,10	1,10	1,10	1,10			
											1,12	1,12	1,12	1,12			
											1,70	1,70	1,70	1,70			
											1,72	1,72	1,72	1,72			
											1,73	1,73	1,73	1,73			
											1,80	1,80	1,80	1,80			
E0923 pests/diseases risks reducing measures											1,10	1,10	1,10	1,10			
										1,12	1,12	1,12	1,12	1,12			
											1,30	1,30	1,30	1,30			
	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34
	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40
E0924 unsustainable use risks reducing measures											1,10	1,10	1,10	1,10			
											1,73	1,73	1,73	1,73			
											1,82	1,82	1,82	1,82			
	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34
	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40
E093 ENVIRONMENT-RELATED IMPACT ALLEVIATION																	
E0931 pollution impact alleviation											1,10	1,10	1,10	1,10			
	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34
	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40
E0932 unsustainable use impact alleviation											1,10	1,10	1,10	1,10			
										1,12							
	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34	3,34
	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40
E101 MANAGEMENT OF INFORMATION ON ENVIRONMENT FOR PROFESSIONAL USE	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
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	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14
	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
											1,16	1,16	1,16	1,16			
	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71	1,71
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74
	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81	1,81
	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82
	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22	3,22
	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31
	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36	3,36
	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38	3,38
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20
E102 MANAGEMENT OF ENVIRONMENT INFORMATION FOR PUBLIC USE	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03	1,03
	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11
	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12	1,12
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	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14
	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15	1,15
											1,16	1,16	1,16	1,16			
	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73	1,73
	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74	1,74
	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82	1,82
	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31	3,31
	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32	3,32
	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33
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	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40	3,40
	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41	3,41
	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10	4,10
	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20	4,20

Code	Actor
0,00	Actor Not Identified
1,00	Government of Mongolia (Cabinet)
1,01	National Water Committee
1,02	National Emergency Man. Agency
1,03	State Spec. Insp. Agency
1,04	Central Lab. State Spec. Insp. Agency
1,05	Center of Standardization & Measurement
1,06	Inst. of Geo-ecol. of Mong. Ac. of Sc.
1,10	Min. of Nature Env. & Tourism
1,11	Water Authority
1,12	Forest Authority
1,13	Meteo. and Env. Mon. Agency
1,14	Central Lab. of Env. Mon.
1,15	Inst. of Meteo. & Hydrology
1,16	Strictly Protected Area Department
1,20	Min. of Rds. Transp. Constr. & Urban Dev.
1,21	Land Aff. Constr. Geod. Cart. Authority
1,30	Min. of Food Agr. & Light Ind.
1,40	Min. of Mineral Resources & Energy
1,41	Energy Authority
1,42	Mineral Resources Authority
1,50	Min. of Health
1,51	Public Health Institute
1,60	Min. of Finance
1,61	Mongolia Tax Authority
1,70	Aimag/Mun. Governor Office
1,71	Aimag/Mun. Spec. Insp. Department
1,72	Aimag/Mun. Emergency Man. Agency
1,73	Aimag/Mun. Dep. of Env. & Tourism
1,74	Aimag/Mun. Center for Meteo. Hydr. & Env. Mon.
1,75	Aimag/Mun. Dep. of Land Rel. Constr. & Urban Dev.
1,76	Aimag/Mun. Dep. of Food. Agr. Small & Med. Ind.
1,77	Aimag/Mun. Health Department
1,78	Aimag/Mun. Tax Division
1,80	Soum/Distr. Governor Office
1,81	Soum/Distr. Special Inspector
1,82	Soum/Distr. Environmental Office
1,83	Soum/Distr. Land Office
1,84	Soum/Distr. Agricultural Office
1,85	Soum/Distr. Tax Inspector
1,90	Bag/Horoo Governor Office
2,00	Parliament of Mongolia
2,10	Aimag/Mun. Citizen Repr. Hural
2,20	Soum/Distr. Citizen Repr. Hural
3,01	Water Sup. & Sew. Oper. Comp. UB
3,02	Housing Services Comp. (OSNAAK)
3,03	Water Sup. & Sew. Oper. Comp. Aimag C.
3,10	Multi- and Bi-lateral Donors
3,21	Large Mining Companies
3,22	Consultants (Companies)
3,23	Private Water Distrib. Comp.
3,24	Private Waste Water Treatm. Comp. UB.
3,25	Private Waste Water Treatm. Comp. Aimag C.
3,31	Mongolian Environmental Civil Council
3,32	Coalition of Civ. Movmnt for Env. Conserv.
3,33	Nat. level NGOs Environm. Monitoring
3,34	Nat. level NGOs Env. Protection/Restoration
3,35	Nat. level NGOs Training Info. & Publ. Awareness
3,36	Nat. level NGOs Env. Research & Studies
3,38	Nat. level NGOs Env. Consulting Services
3,39	Loc. Level NGOs Environm. Monitoring
3,40	Loc. Level NGOs Env. Protection/Restoration
3,41	Loc. Level NGOs Training Info. & Publ. Awareness
4,00	National IWRM Organisation
4,10	River Basin Committees
4,20	Sub-River Basin Committees

Annex 6: River Basin Organisations established as per December 2011

Name of Aimag	Name of river	Basin #	Resolution number/date	Remarks
River Basins (established by Minister's order)				
Bayan-Ulgii, Uvs, Khovd	Khovd and Buyant rivers	28	#59, 17 March 2009	Supported by WWF, SDC
Dornod, Khentii	Onon river	12	#108, 19 April 2010	Supported by WWF
UB, Tuv, Bulgan, Arkhangai, Selenge, Uvurkhangai,	Tuul river	9	#268, 31 August 2010	Supported by IWRM project
Zavkhan, Gobi-Altai	Zavkhan river	24	#153, 12 May 2011	Supported by Asian Foundation
Darkhan-Uul, Selenge, Tuv	Kharaa river	10	#319, 28 September 2011	Supported by MoMo project
Darkhan-Uul, Orkhon, Arkhangai, Bayankhongor, Uvurkhangai, Bulgan, Selenge	Orkhon river	8	#456, 20 December 2011	Supported by IWRM project
Sub basins (established by Resolution of Aimag and City level parliament)				
Uvs	Khangiltsag river	29	#88, 28 June 2006	Not active
Uvs	Teeliin river	29	#88, 28 June 2006	Not active
Uvs	Khundlun river	29	#88, 28 June 2006	Not active
Uvs	Namir river	29	#88, 28 June 2006	Not active
Uvs	Nariin river	29	#88, 28 June 2006	Not active
UB districts	Selbe river	9	#78, 21 May 2008	Not active
Bayankhongor	Baidrag river	23	#73, 7 April 2009	Not active
Bayankhongor	Tuin river	22	#73, 7 April 2009	Not active
Khentii	Ikh shaazgai river	12	#40, 28 October 2009 (soum parliament resolution)	Not active
Selenge	Eroo river	11	#76, 6 July 2010	Not active
Uvurkhangai	Taats river	21	#96, 19 November 2010	Not active

[Source: Adopted from official documents of Water Authority of Mongolia, 2010, 2011].

Annex 7: Laws in Mongolia that regulate the protection of the environment, the proper use of natural resources and the restoration of available resources.

No	English Name	Adopted in [yy-mm-dd]	Latest Amendments [yy-mm-dd]
	Air related laws		
1	Law on Air	1995-03-31	2002-07-10
	Animal related laws		
1	Law on Payments and Authorization Fees for Game Resources Hunting and Trapping	1995-05-22	2006-06-29
2	Law on Ban Controlling and Examination during transportation through border of animals, plants, and raw materials or products of their origin	2002-11-28	
3	Law on Fauna	2000-05-05	
4	Law on Gaming	2000-05-05	2002-04-25
5	Law on Controlling of Foreign Trade of Rare Animals, Plants and Products of their origin	2002-11-07	
	Environment related laws		
1	Law on Investment Percentage of Revenue generated from Natural Resource Usage Payments for Measures to protect environment and rehabilitate natural resources	2000-01-28	2004-04-22
2	Law on Environmental Impact Assessments	1998-01-22	2006-05-25
3	Environmental Protection Law	1995-03-30	2008-01-31
	Land related laws		
1	Law on Mineral Resources	2006-07-08	
2	Law on Land	2002-06-07	2006-12-22
3	Law on Land Fees	1997-04-24	2006-12-08
4	Law on Subsoil	1988-11-29	1995-04-17
5	Law on Land Cadastre and Mapping	1999-12-16	2005-01-27
6	Law on Land Privatization for Citizens of Mongolia	2002-06-27	2008-05-22
7	Law on Buffer Zone of Special Protected Areas	1997-10-23	
8	Law on Special Protected Areas	1994-11-15	2006-12-22
9	Law on Geodesy and Mapping	1997-10-31	2005-01-27
	Water related laws		
1	Law on Spring Water	2003-11-07	
2	Law on Meteorology and Environment Monitoring	1997-11-13	2003-01-02
3	Law on Fees for the Use of Water and Springs	1995-05-22	2004-12-02
4	Law on Water Transportation	2003-11-28	
5	Law on Water	2012-05-17	2012-08-17
6	Law on Urban Water Supply, Sanitation Sewerage Use	2002-06-13	2005-01-27
7	Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas	2009-07-16	
	Forest related laws		
1	Law on Protection of Forest and Steppe from Fire	1996-05-28	1999-0-28
2	Law on Payments for Harvest of Forest Timber and Fuel wood	1995-05-19	2000-01-27
3	Law on Forest	2007-05-17	2008-01-31
	Agriculture and plant related laws		
1	Law on Usage Payments of Natural Plants	1995-05-19	
2	Law on Natural Plants	1995-04-11	
3	Law on Cultivation	2004-04-22	2006-06-29

No	English Name	Adopted in [yy-mm-dd]	Latest Amendments [yy-mm-dd]
4	Law on Seed, Sorts of Cultivated Plants	1999-06-17	
5	Law on Plants Protection	2007-11-15	
6	Law on Insurance of Seed Planting	1999-07-02	2002-12-26
Waste & chemicals related law			
1	Law on Household and Industrial Waste	2003-11-28	
2	Law on Prohibition of Importing, Exporting and Transiting of Dangerous Wastes	2000-11-03	
3	Law on the Protection of Toxic Chemicals	2006-05-25	
4	Law on Radiation Safety	2001-06-21	2003-01-02
Border, state security & emergency related laws			
1	Law on Border of Mongolia	1993-10-21	2001-12-27
2	Law on Emergency	1995-11-14	
3	Law on National Security	2001-12-27	2004-04-23
Other laws			
1	Law on Construction	2008-02-05	
2	Law on Administrative Liability	1992-11-27	2008-05-20
3	Civil Code	2002-01-10	2003
4	Constitution Law of Mongolia	1992-01-13	2000
5	Law on Renewable Energy	2007-01-11	
6	Law on Free Zone	2002-06-28	2003-01-02
7	Criminal Code	2002-01-03	2008-02-01
8	Law on Food	1999-10-07	2003-05-15
9	Law on Sanitation	1998-05-07	2001-01-30
10	Law on Tax	2008-05-20	2009-10-30
11	Law on Government	1993-05-06	2009-06-11
12	Law on Parliament	2006-01-26	

Annex 8: Changes in Government structure as per August 2012

Previously (2008 – 2012)		Effective August 2012	
Prime Minister		Prime Minister	
First Deputy Prime Minister		Deputy Prime Minister	
Deputy Prime Minister			
Minister of the Cabinet Office		Minister of the Cabinet Office	
Ministry of Nature, Environment and Tourism	MNET	Ministry of Environment and Green Development	MEGD
		Ministry of Culture, Sports and Tourism	MCST
Ministry of Education, Culture and Science	MECS		
		Ministry of Education and Science	MEC
Ministry of Foreign Affairs and Trade	MFAT	Ministry of Foreign Affairs	MFA
		Ministry of Economic Development	MED
Ministry of Finance	MF	Ministry of Finance	MF
Ministry of Justice and Home Affairs	MJHA	Ministry of Justice	MJ
Ministry of Roads, Transportation, Construction and Urban Development	MRTCUD	Ministry of Construction and Urban Development	MCUD
		Ministry of Roads and Transportation	MRT
Ministry of Defence	MD	Ministry of Defence	MD
Ministry of Mineral Resources and Energy	MMDE	Ministry of Mining	MM
		Ministry of Energy	ME
Ministry of Food, Agriculture and Light Industry	MFALI	Ministry of Industry and Agriculture	MIA
Ministry of Social Welfare and Labour	MSWL	Ministry of Population Development and Social Welfare	MPDSW
		Ministry of Labour	ML
Ministry of Health	MH	Ministry of Health	MH

Annex 9: Relation between integration categories and types of coordination.

Integration category	Type of co-ordination	Purpose of co-ordination	Discussion
Political	Stakeholder	Attaining participation of all stakeholders in the decision-making through processes of coordination and conflict resolution.	Coordination through stakeholder involvement is well-known in the water sector, both in planning approaches, such as Integrated Resource Planning, and in public involvement in general. Stakeholders include a broad spectrum of individuals, groups and organizations (see box), who definitely cannot be considered equals when negotiating compromises. There are those who control the means (knowledge, finances, equipment) and the decisions (managers, politicians), whose co-operation is needed to keep the system working; their continued co-operation is their bargaining chip in negotiations. Then there are those using the services of the water system or are adversely affected by the management of the water system (water users, environment, etc.) who find themselves in an extremely dependency situation without any bargaining chips for negotiation. To further distort the power balance around the negotiation table there may be those in a position to ignore whatever compromise is decided on (multi-national companies, or individuals, groups or companies who enjoy protection at the highest levels of power). National and local parliaments are means for stakeholder co-ordination, but generally considered too broadly mandated to be effective for water management. Water councils in many forms are usually resorted to for stakeholder co-ordination with varying success. In Mongolia the first steps have been set to establish River Basin Councils to achieve stakeholder co-ordination.
	Intra-governmental	Achieve the participation of all (relevant) units of government in the decision-making through processes of coordination and conflict resolution	Intragovernmental coordination is given as separate from stakeholders because of the different kinds of authorities that government has. Government organizations are characterized by strong hierarchal decision-making procedures and primarily geared to achieving their own objectives. Compromises are considered political decisions, which are not made at the bureaucratic level. In Mongolia the National Water Committee is an example of attempting intragovernmental co-ordination in the water sector. By far most actors in water management are government organizations in Mongolia.
	Local and regional concerns	Taking into consideration local and regional variations	Local and regional coordination in the context of political integration refers to the vertical dimension of local-state co-ordination, where national objectives are not at par with local interests. At a higher level local and regional co-ordination would also include trans boundary issues, which may touch on all kind of water management issues (and beyond) very much depending on each situation. Mongolia shares boundaries with China and Russia. With both countries formal relations are maintained through committees that meet at least once a year to discuss and co-ordinate management of shared rivers.
			In the context of geographic integration, local and regional co-ordination would deal with a horizontal dimension of co-ordination. In Mongolia this would at the moment be limited to basin transfers where water from mountainous areas with high rainfall, low population and economic activity would be transferred to arid and semi-arid regions with high population or economic activities. Examples are the proposed Orkon–Gobi and the Kherlen transfers to supplement the meager water resources of the south and eastern Gobi areas.

Geographic	Watersheds and natural water systems	Planning and management on the basis the natural water systems	In the context of geographic integration, co-ordination in water sheds and natural water systems would mainly refer to upstream-downstream issues. In Mongolia many upstream-downstream issues exist both with respect to water quantity as well as water quality. It are in particular these issues that triggered the introduction of the concepts of river basin management in Mongolia. It is therefore of no surprise that the first river basin organizations to be established are in basins with severe water quantity and water quality issues in a) the Hovd/Buyant basin and b) the Tuul and Orkhon basins
			Coordination in watersheds is currently very popular, as it is much more logical to manage a water system as a whole within its natural boundaries than to manage it in fragments decided by administrative boundaries that only rarely have a hydrological basis; administrative boundaries seldom coincide with water divides, but often do coincide with rivers itself. With a river as administrative boundary dividing its left and right bank already the first obstacle for optimal management of the river's waters is in place. The answer is to make river basin organizations responsible for water management. However, when establishing RBOs the local administrations do not disappear, but just remain in place; only water management issues are transferred to the RBOs. Clearly the introduction of RBOs to ease the coordination within watersheds and natural water systems immediately introduces another need for co-ordination, i.e. the need for co-ordination between local administrations and their overlapping RBOs. This type of co-ordination would be covered by the stakeholder and the intergovernmental co-ordination types, and obviously places much more weight on these types of coordination.
Hydro-ecological	Water quality and quantity	Enhancing water quality and quantity	Coordinating water quantity and quality in the context of hydro-ecological integration becomes an issue when water demand is high in comparison to the resource's capacity and/or when the pollution load on the resource exceeds its natural capacity to purify. In Mongolia this is only the case in a few specific cases: the Tuul River around Ulaanbaatar being the most prominent. The basin management approach is only one of the tools to deal with this. Another promising tool is known as the 'environmental flow' approach. In the case of Mongolia considerably more scientific research is needed to enable the successful application of the environmental flow approach. Until then a conservative withdrawal of maximum 5-10% of the river flow is considered ecologically safe. Though not a major issue yet, it will increasingly become a major concern of environmental policy in Mongolia especially with the projected developments in mining and energy.
Purpose or function	Competing uses	Balancing competing uses of water through efficient allocation that takes into account social values, cost effectiveness, and environmental benefits and costs	In Mongolia coordinating competing uses is less an issue than in the rest of the world due to its extremely low population density. Nevertheless Mongolia does have a few 'hot spots' where the issue of competing uses are apparent such as around some of the major population centers and the mining and industrial sites in the south of the country. Coordination will not completely solve issues like this in particular when it involves property rights and traditional values. Systems for conflict resolution will increasingly be needed.

Disciplinary	Society and environment	Exercising stewardship of water resources for the greatest good of society and the environment	Coordination between society and environment is a general goal that has educational value but does not really deal with the practical details of coordination needed in water management. The concept of coordinating society and environment can be mainly used for public relations, public awareness and educational purposes with the chief aim to improve clarity and gain more acceptance. Many NGOs are active in particularly this field. Improving the co-operation between the actors in water management and NGOs would be mutually beneficial. With NGOs seldom being accepted as an equal partner in water management they often resort to adopting an antagonistic role. This is not the most efficient way of achieving objectives.
	Means of water management	Promoting water conservation, demand management, reuse, source protection, and supply development	Coordinating the means of water management requires full consideration and appreciation of all available options. Good planning and engineering are required for such full consideration. The preference for the supply development option by a dominant engineering lobby needs to be properly counterbalanced. Responsible organizations need to avail over well trained experts in all fields with up to date expertise and state of the art methodologies, equipment, models and software. A policy needs to be in place to continuously improve education at all levels ensuring a steady supply of highly qualified expertise.
Data and information	Time-wise	Adapting to changing conditions timely, effectively and efficiently	Improving time-wise co-ordination will require more appreciation for the value of planning as a coordination tool. In this context 'planning' is much more than 'making plans'. With planning one attempts to prepare oneself for an uncertain future, which means all possible scenarios have to be considered and solutions have to be tested against all these scenarios. Risk and cost/benefit analyses, robustness testing under varying scenarios are integral parts of a planning process. Another major element of time-wise co-ordination is the preservation and sharing of institutional memory. To avoid repeating the same mistakes and re-inventing the wheel over and again it is required that records are kept and made freely available, monitoring and impact assessments are carried out regularly and the outcomes, no matter whether they are positive or negative, are published and shared freely.

Part 8.
STRENGTHENING HUMAN RESOURCES IN THE WATER SECTOR

Prepared by: N.Chagnaa[1], Consulting engineer of Mongolia

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Reviewed by: G.Dolgorsuren[1], Doctor (Ph.D)

[1] *"Strengthening Integrated Water Resources Management in Mongolia" Project*

Contents

List of Figures

1. 2009 report on human resources in the water sector

A detailed study of the human resources situation in water sector was carried out considering the period since the beginning of formal staff preparation in view of that specialists and skilled workers with higher and specialized vocational education in the given field should to be included in the Water sector human resources.

The following organisations were included in the survey:

- Water Authority
- Ministry of Education, Culture and Science
- Mongolian University of Science and Technology (MUST)
- National University of Mongolia (NUM)
- Mongolian State University of Agriculture (MSUA)
- Water Supply and Sewerage Company (USUG)
- National Centre for Construction, Urban development and Public utility (NCCUP)
- Geo-Ecology Institute
- Water Institute
- Institute for Human Resources
- and over 140 companies operating in the water sector.

There is not any organization formally responsible for collecting information related to specialists and skilled workers with the special secondary education and overseas training in the water sector. Presently, only USUG and NCCUP prepare monthly and annual reports on water sector staff. Therefore this report relies on information gathered from interviews and estimations.

In this context research work focused on engineers graduated from the universities and 1150 engineers were included in the survey as follows:

- graduates from the MUST of the 4th - 38th graduation as engineers on water construction, hydro-electric power station, water resources, ecology, hydrogeology and geophysics
- graduates from the NUM as hydrologists
- graduates from the MSUA as agronomists for the irrigated cropping industry
- 41 masters who completed these universities between 2002 and 2008
- and 14 doctors (PhD) graduated from the MUST.

The numbers of specialists and skilled workers with specialized vocational education in the water sector have been estimated.

Use is made to the report “Human resource management in the water sector” (2007) by Dr. N.Soninkhishig, which is considered in conjunction with this report.

2. Outcomes of the survey

2.1. Hydro construction engineers

Between 1966 and 2008, 38 graduations took place at MUST and 682 students completed their training as of hydro-construction engineers, water resource and ecology. Just over one third of these graduates were female (see Figure 1 and by 2009 less than 40% of these graduates were still working in the water sector (see Figure 2).

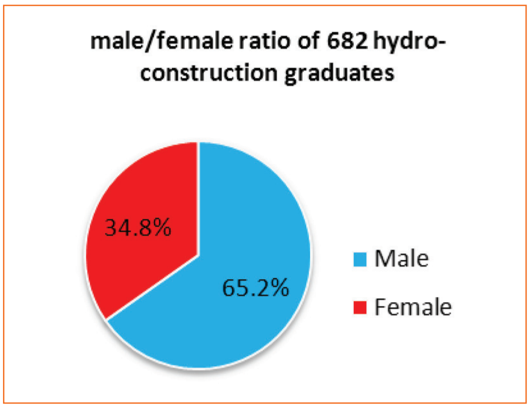

Figure 1. Gender ratio of the hydro-construction engineers graduated since 1966

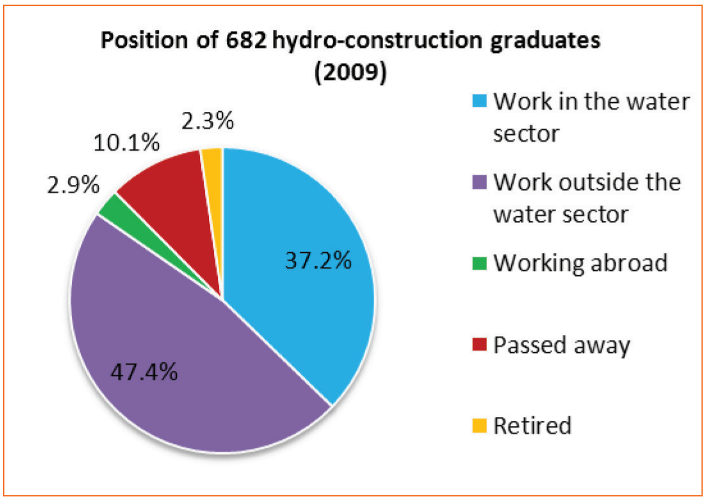

Figure 2. Position of the hydro-construction graduates

About 2/3 of the 255 graduates who still work in the water sector actually works as a professional engineer, others have become civil servants (18%) or are in management positions in the private sector (13%).

Of the 578 graduates working in and outside the water sector in Mongolia 552 graduated after 1971 and are aged less than 60 years and 396 graduated after 1981 and are less than 50 years of age. The percentages of them working in and outside the water sector are indicated in Figure 3 showing a tendency of the younger generation increasingly finding employment outside the water sector (for more details see Annex 1)

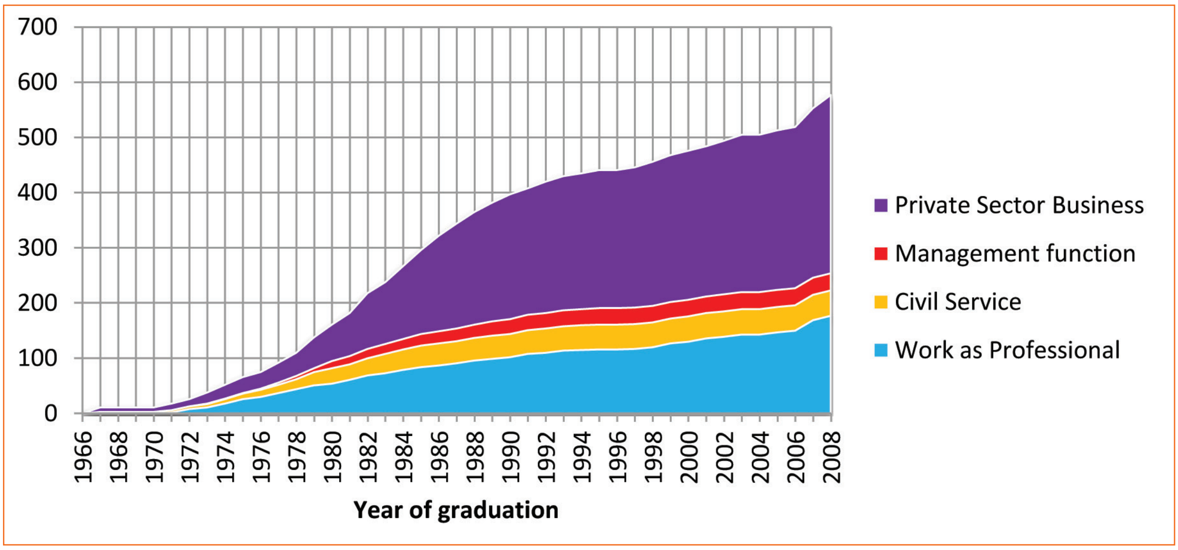

Figure 3. Employment of the hydro-construction graduates working in Mongolia

As of 2009, 154 students were studying at the environmental engineering faculty of the MUST 72 of those studied Water Construction and 82 Water Resource and Ecology. In 2009, 37 of these students graduated, an increase of 32.4% from 2008, indicating the number of graduates at MUST is growing (see Annex 2).

Till 1990 Mongolia maintained a planned economic system. During that period the requirements for cadre and students were defined on the basis of five-year plans. The growth and decline of water sector's specialists with higher education is shown in the Figure 4, while Annex 4 presents an explanation for this variation in an historical context for the periods 1-4.

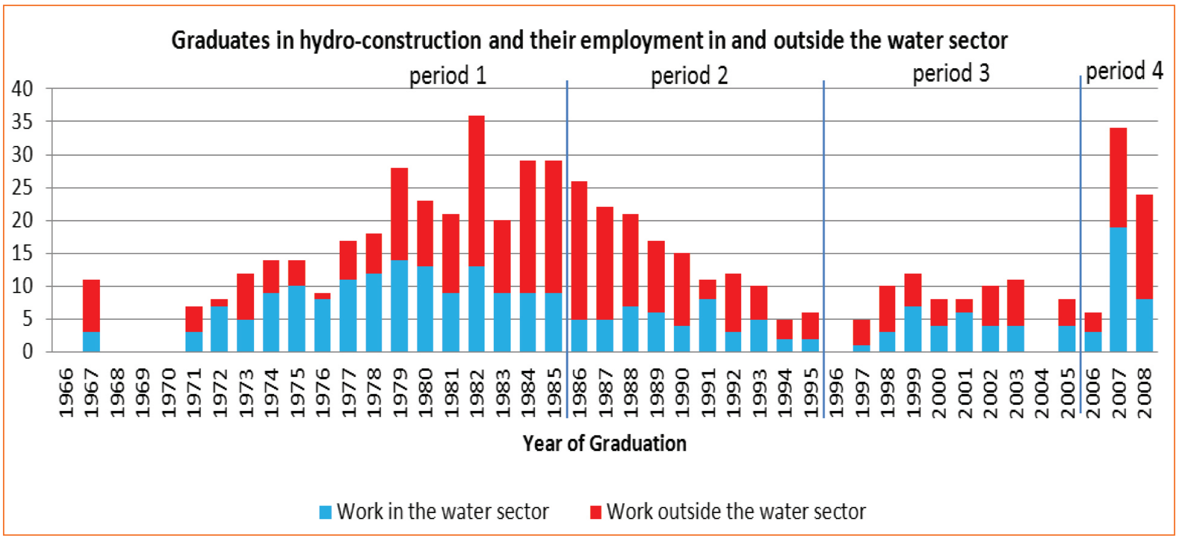

Figure 4. Variation of graduates in hydro-construction in subsequent periods

The number of engineers and hydro technicians increased sharply in 1971-1985 due to the intensive development of water sector in 1971-1985. As a result Mongolia's water sector was further decentralized. The changes of the social system in the 1990s led to severe decline in the number of students in water related subjects which lasted till about 1995.

During 1996-2005 management of the water sector was all but neglected. Only after the adoption and implementation of the National Water Program and the Water Law (2004) domestic and foreign investment in the water sector was reignited. Also the establishment of the Water Authority attracted the attention of the universities and the decline of the number of students in water construction engineering was reversed. Following an increasing national budget for the restoration and construction of wells and irrigation system and an increase in investments from abroad in the water sector the number small private enterprises in the water sector started to rapidly grow. This triggered a demand for engineering staff and the trend of increasing numbers of engineers being engaged outside the water sector reversed.

2.1.1. MScs and PhDs

Only since early 2000 can the Master degree in the field of water sector be earned formally at the Mongolian universities. During the 1990s senior engineers and hydro technicians who graduated from the MUST or a foreign university prior to 2000 were given the opportunity to formally have their diploma acknowledged as an MSc degree on application and paying a nominal administration fee. This report does not included these "upgraded" MSc's, but only includes engineers who successfully completed the MSc program for hydro-construction during 2002-2008. During this period 20 engineers (14 male and 6 female) have defended their MSc thesis in the field of hydro-construction, water supply and sanitation. All of them still work in the water sector (see Annex 5).

The opportunity to defend an PhD thesis in the field of water science became available in 1967. For graduates from MUST it became available in 1990. At present about 70 persons have successfully defended an academic thesis in water related sciences. In analysis only 6 MUST graduates who defended an academic thesis during 1994-2006 are included (see Annex 6). When defending their academic thesis these 6 engineers were aged between 35 and 48 years.

2.1.2. Specialists with special secondary education

Training of specialists at specialised secondary education institutions for the water sector has been available since the 1937-1938 academic year. The specialised secondary schools prepared water sector specialists for more than 60 years. Only during the period 1951-1988 861 hydro technicians with special secondary education completed this school.

In 1994 this type of technical training was abolished. At present there are about 500 hydro technicians aged up to 55 with this special secondary education of whom about 300 are less than 50 years old. It estimated that about 30% or about 100 water technicians from the above group of persons are employed in the water sector (wells, irrigation and water supply systems construction).

2.1.3. Skilled workers in the water sector

Training of professionals for the water sector started in the 1930s in the form of apprenticeship. From the 1940s part-time courses became available. Full-time courses for the water sector were initiated in 1974 in Ulaanbaatar and the water sector vocational and technical school (VTS) for 600 trainees was opened in Arvaikheer town of Ovorkhangai aimag. This greatly contributed to the preparation of professional staff for the water sector.

As a result by 1986 almost 90% of total work force of about 2700 workers in the water sector was trained professionals. At present about 1800 persons in this workforce are aged below 50 years old. About 200 of them are working in repair and operation of wells and irrigations system, and drilling of waterholes. In the period 1975-1985 1470 persons completed Ovorkhangai VTS in 19 different professions. Most of them are now aged about 50 years old. From this group about 400 experienced workers would still be available for the water sector. Quite a number of the current professional workers were trained in the former Soviet Union.

2.2. Hydrogeology specialists

During the 25 graduations between 1978 and 2008 305 engineers have graduated from the MUST as hydrogeologists, almost 60% of them are male (see Figure 5) and by 2009 about 2/3 of these graduates were still working in the water sector (see Figure 6).

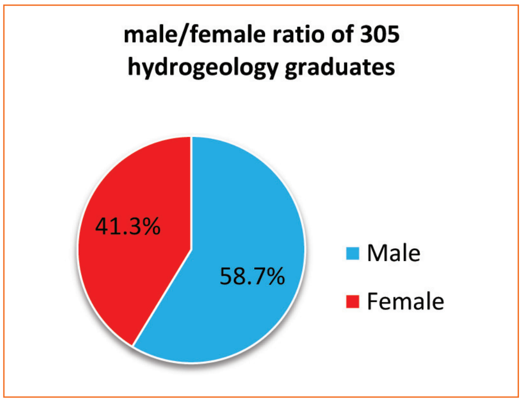

Figure 5. Gender ratio of the hydro-geologists graduated since 1978

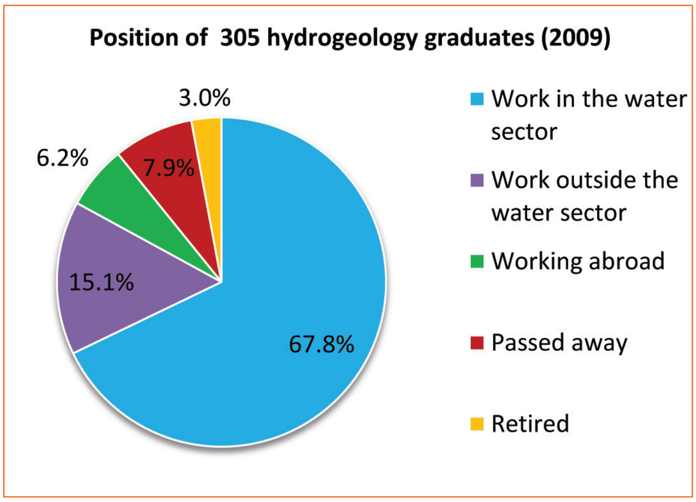

Figure 6. Position of the hydrogeology graduates by 2009

More than half (52.2%) of the 207 graduates who still work in the water sector actually works as a professional engineer, others have become civil servants (30.4%) or are in management positions in the private sector (17.4%).

At present 253 hydro-geologists are less 50 years old and work in Mongolia and more than 80% of them work in the water sector. This is a considerably higher percentage than the hydro construction engineers (see Figure 7).

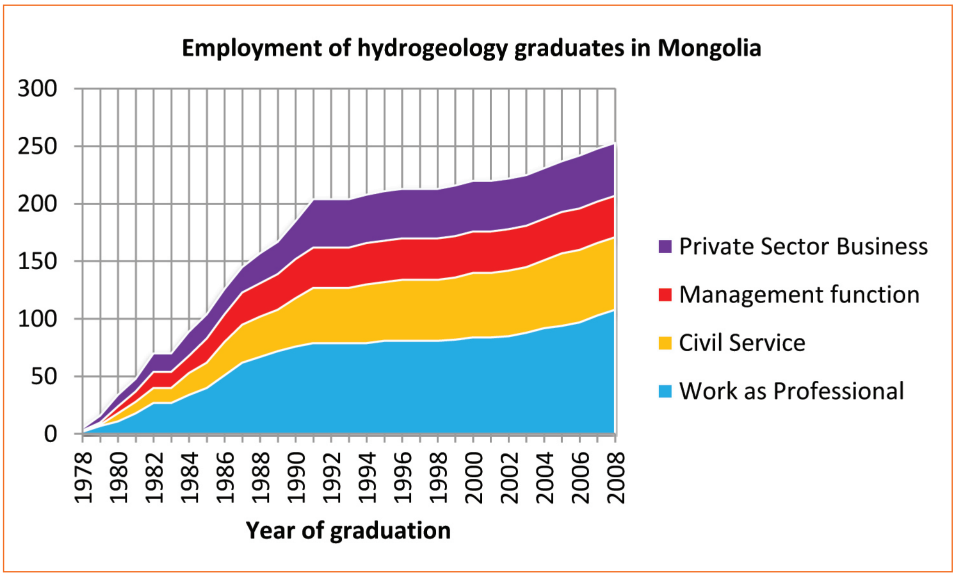

Figure 7. Employment of the hydrogeology graduates working in Mongolia

In 2009 the hydrogeology faculty of MUST had total of 45 students including 24 first-year and 21 fourth-year students. In 2009, 21 students graduated as the hydro-geologists (See Annex 2 and Annex 7).

Reviewing the growth, decline and employment in the five-year periods of hydro-geologists graduated from MUST from 1981till 2008 it appears that the number of graduates is more close to the need of professionals as out of the 8 engineers on average graduating every year during these 28 years 6 or 7 actually work in the water sector (see Figure 7 and Annex 3).

2.2.1. MScs and PhDs

The MSc training for the hydro-geologists was similar to that of the hydro-construction engineers. Of the 15 hydro-geologists graduated from MUST and who successfully defended their master degree in the period 2002-2008 12 serve in their profession or in the public sector, and 1 works in the private sector, while 2 found employment abroad (see Annex 5).

The number of persons defending a PhD thesis in the field of geology or hydrogeology is increasing since the beginning of the 1970s. Of the 8 specialists who graduated from MUST as the hydro-geologists and successfully defended the academic thesis since 1995, 3 graduates wrote their thesis on the professional theme and 5 on theme of applied sciences at the age of 28-45 (see Annex 8).

2.2.2. Hydro-geologists with specialized vocational education

Till 1968 soviet technicians and hydro-geologists were working in the water sector industry. Meanwhile an estimated 500 hydrogeology technicians have completed training at the Water College between 1968 and 1994. Around half of those are aged up to 45 and a considerable number of these technicians are experienced in drilling works. Out of this group selected persons may be retrained by which for the immediate future over 100 hydro-geologists with specialized vocational education may be trained.

2.3. Geophysical engineers

In connection with that the requirement for using the geophysical methods in the prospecting of the underground water resources was increased, the training of geophysical engineers and operators (for the water sector industry) has been started since 1958. Then first 2 engineers graduated in the USSR as the geophysicists began to work in this sector from 1968. Till 1998 the geophysical engineers for water prospecting have been trained abroad.

During the period from 1998 till 2008 120 geophysicists graduated from MUST, the majority being male (see Figure 8) and about 2/3 of the graduates work in the water sector (see Figure 9) Geophysical engineers are not only employed in the minerals and mining reconnaissance but also prospecting for underground water resources. So, the need in these specialists is likely to be relatively high (See Annex 9).

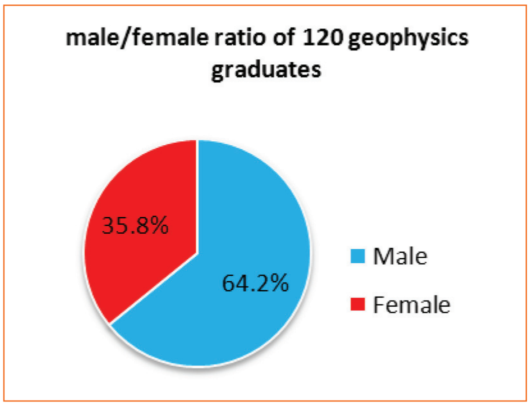

Figure 8. Gender ratio of the geophysicists graduated since 1998

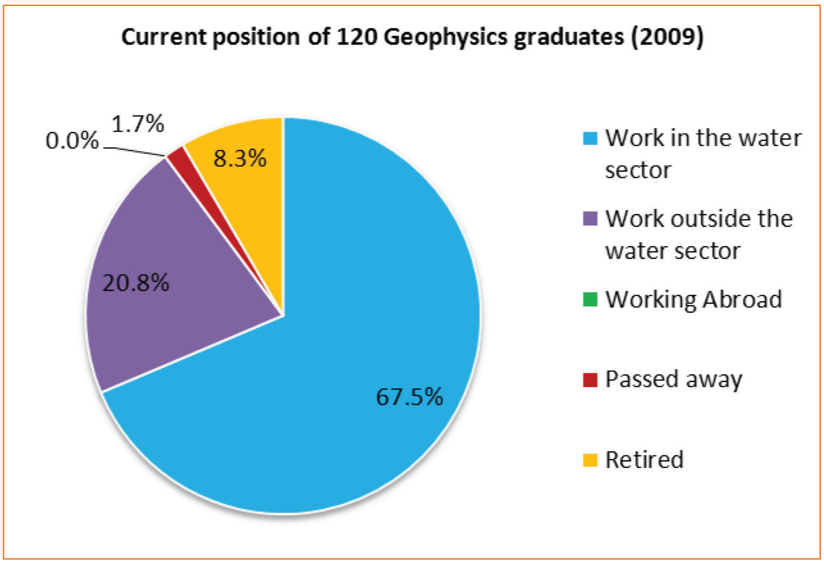

Figure 9. Position of the geophysics graduates by 2009

Since these specialists graduated from the MUST during 1998-2008 they are relatively younger and are on average between 24 and 34 years old. From 2001 the number of geophysicists trained at MUST has sharply increased; after 2005 the number of graduates stabilized but the number of those finding employment outside the water sector decreased by (see Annex 9; Figure 10).

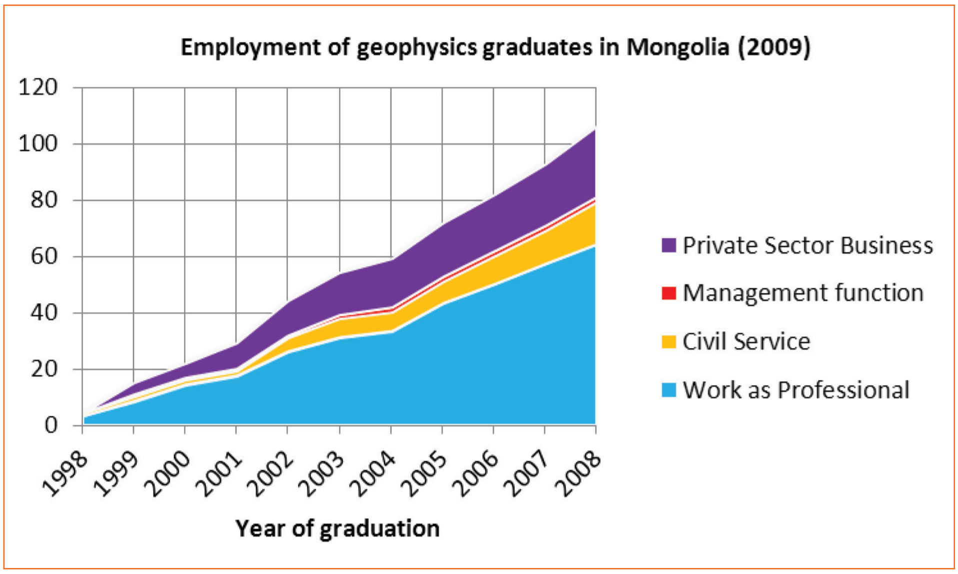

Figure 10. Employment of the geophysics graduates working in Mongolia in 2009

The data show a steady supply of fresh graduates in geophysics. No information was found on successful defending of MSc and PhD theses, which would assume there have been no MSc and PhD degrees been awarded in geophysics yet.

2.3. Engineer-hydrologists

NUM is offering hydrology courses since 1995, but there were no graduations in 1997, 1999, 2002, 2003 and 2004. Between 1995 and 2008 a total of 89 hydrologists, of whom the majority is female (see Figure 11) have graduated and their present positions are indicated in Figure 12.

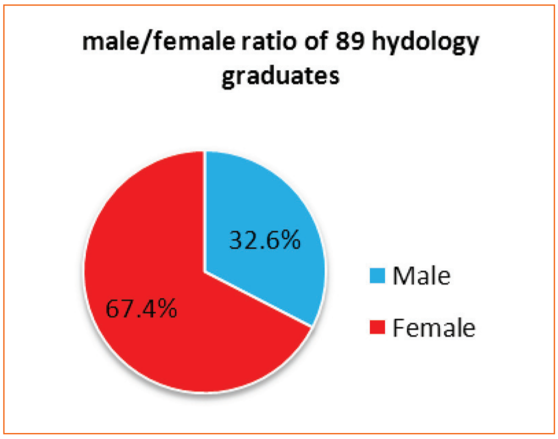

Figure 11. Gender ratio of the hydrologists graduated since 1995

The 80 hydrologists working in Mongolia at present are young people aged between 25 and 37.

In 2009 a total of 70 students were studying at the hydrology faculty of the NUM and 18 students became the hydrologists in 2009, which is the second highest number for hydrologists in one year. The number of students in this field has tendency is growing, but the number of hydrology graduates seeking employment outside the water sector is rapidly increasing (see Annex 2; 10; 11 and Figure 13). There might be a relation with the relatively high percentage of women in the profession.

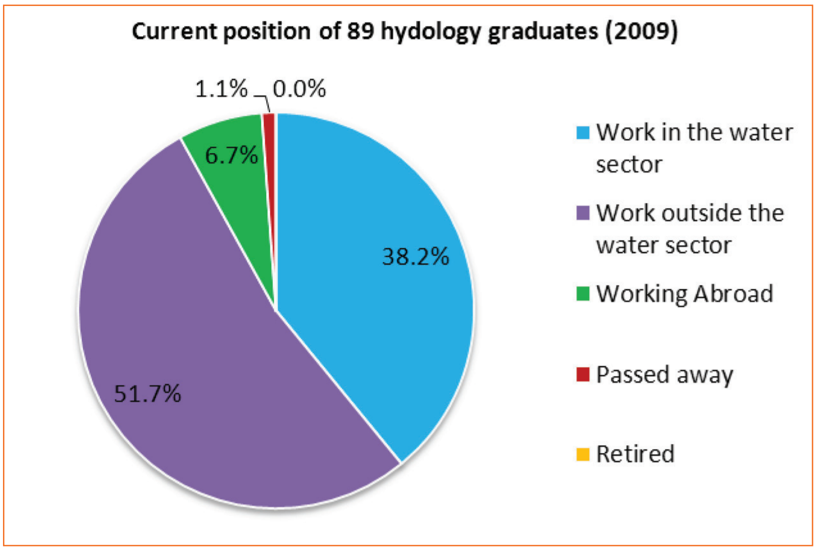

Figure 12. Position of the hydrology graduates by 2009

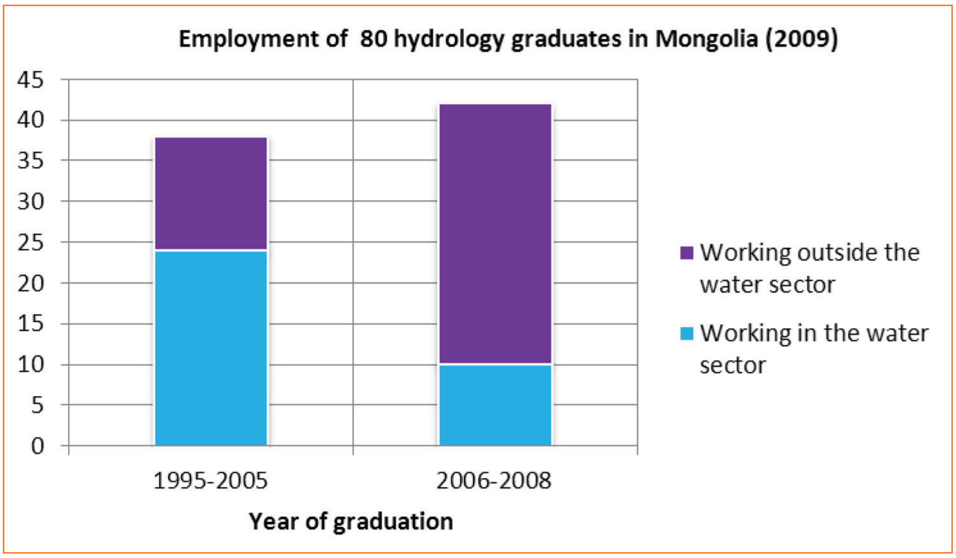

Figure 13. Employment in and outside the water sector of hydrology graduates

2.3.1. MScs and PhDs

Of the 89 hydrologists graduated from the NUM three have defended the master thesis during the period 2002-2008 and still work on their field of expertise.

2.4. (Irrigation) Agronomists

The Mongolian State University of Agriculture provides courses for agronomists for the irrigated agriculture since early 2000 and 21 agronomists graduated between 2005 and 2008. By now (2009) these graduates are still young and aged on average between 23 and 26 years old. The gender distribution of the graduates is fairly balanced (see Figure 14)

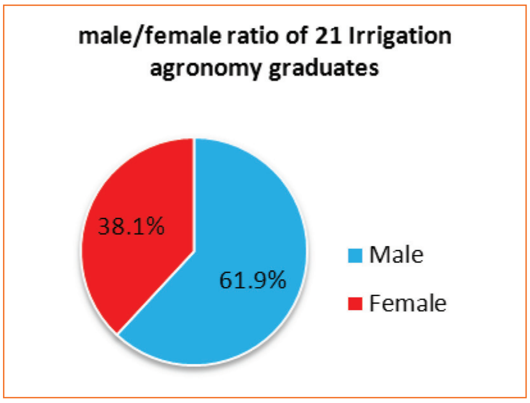

Figure 14. Gender ratio of the agronomists graduated since 2005

At present the majority of these graduates work in the irrigated agricultural sector (see Figure 15)

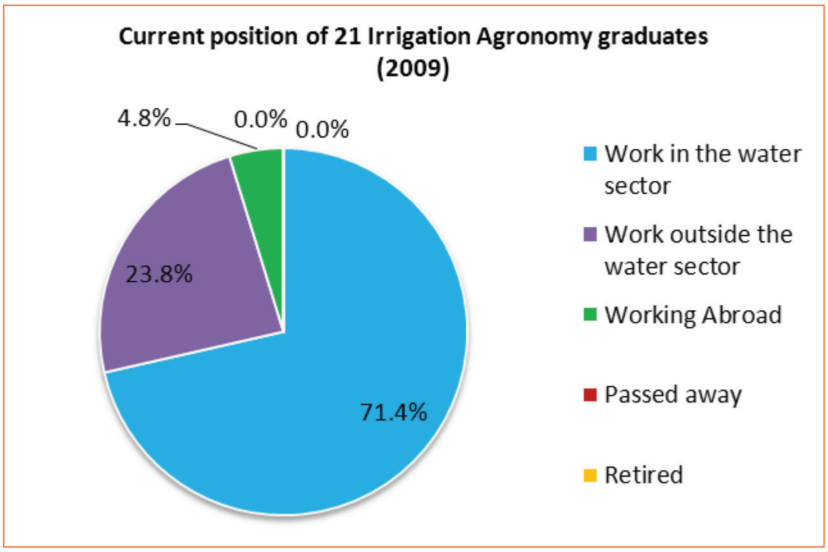

Figure 15. Position of the agronomy graduates by 2009

As of 2009 25 students were enrolled in agronomy courses at the MSUA and 6 of them graduated in 2009. The employment outside the sector is increasing (See Annex 11-13; Figure 16). The number of agronomists employed within the sector has remained constant, while the number of agronomists taking up management functions and employment outside the sector is rapidly increasing. This trend is a cause for concern.

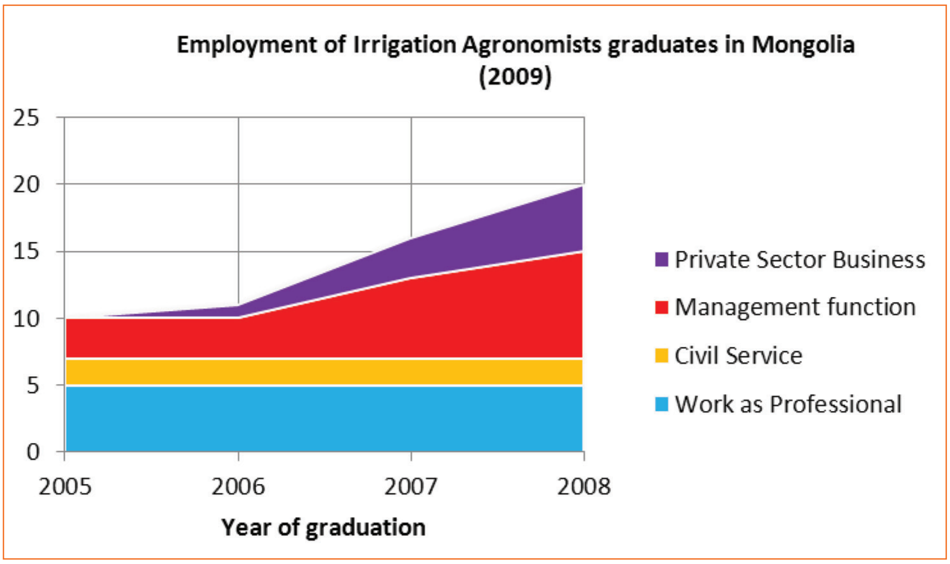

Figure 16. Employment of the agronomy graduates working in Mongolia in 2009

3. Human resource in the Water sector

The present situation of specialists and professionals with higher and specialized vocational education, personnel's growth in 2009-2015 and statistics defined in dependence on the situation of personnel's decline in the same time should relate to the human resource in the water sector. In order to define the statistics of human resource,

On the basis of the historical data the following key figures are assumed:

- Gender ratio male/female:

Hydro-construction engineers:	0.60/0.40
Hydrogeological engineers:	0.60/0.40
Geophysical engineers:	0.64/0.36
Hydrologists:	0.33/0.67
Agronomists:	0.62/0.38

- Percentage of persons retiring directly when reaching the pension age is 70%
- Percentage of graduates leaving the sector choosing employment outside the sector:

Hydro-construction engineers:	50%
Hydrogeological engineers:	15%
Geophysical engineers:	21%
Hydrologists:	57%
Agronomists:	24%

- Average number of graduates per year:

Hydro-construction engineers:	15
Hydrogeological engineers:	8
Geophysical engineers:	10
Hydrologists:	11
Agronomists:	5

- Estimate for graduates returning from employment outside the sector is 20%
- Estimated percentage of graduates emigrating after completing their studies annually:

Hydro-construction engineers:	0.2%
Hydrogeological engineers:	0.2%
Geophysical engineers:	0.9%
Hydrologists:	1.0%
Agronomists:	1.0%

- Percentage of graduates retiring each year:

Hydro-construction engineers:	0.5%
Hydrogeological engineers:	0.1%
Geophysical engineers:	no graduates are due for retirement for the next 10+ years
Hydrologists:	no graduates are due for retirement for the next 20+ years
Agronomists:	no graduates are due for retirement for the next 30+ years

The estimate of the available water sector's human resources is based on the number of engineers, technicians with specialized vocational education and skilled workers presently working in Mongolia.

The number of the technicians with specialized vocational education and skilled workers included here are estimates because there is no information on their professional breakdown. Graduates from the foreign universities, colleges and specialised vocational schools are not included due to lack of information. In general it can be stated that graduates from foreign countries are mostly employed people of good capacity.

Overall, the required human resources of 885 persons (391 hydro-construction engineers, 232 hydro-geologists, 137 geophysicists, 82 hydrologists, and 43 agronomists) would be filled by graduates from the domestic universities, colleges and other schools by 2015. The currently available human resources are 649 or 73,3% of the requirement (see Annex 14).

Furthermore, a total of 672 specialists with specialized vocational education (360 hydro-technicians and 312 hydro-geologists) will be required by 2015 in of which 560 or 83.3% are currently working or available to work in the sector. In order to provide with above-mentioned specialists with specialized vocational education by 2015 it is required to start their training from 2010 (See Annex 15).

The skilled workers play the decisive role in both of the water sector construction and operation and maintenance. The estimated number available at this moment is 520 skilled workers. Hence when training of new staff commences in 2010, an estimated number of 1187 skilled workers may be reached by 2015 (see Annex 16).

4. Need for personnel in the water sector

Based on the proposed measures and activities reflected in the Millennium Development Goals of Mongolia, the Comprehensive Policy for the National Development, the Action Plans and Programs of the Government, the Program for providing the population with drinking water, the Ulaanbaatar Regional Development Program and the National "Water" Program Project etc., an attempt is made to estimate the personnel requirements for the water sector (see Annex 17).

The number of professionals needed for implementing 23 selected larger measures to during 2009-2015 is estimated at 3786 persons as follows:

Hydroconstruction engineers:	597
Hydrotechnicians with specialized vocational training:	282
Hydrogeologists:	348
Hydrologist:	295
Ecologists:	119
Irrigation agronomists:	25
Skilled workers:	1477

Of these required personnel 39.0% will be skilled workers, 41.5% engineers and 19.5% workers with specialized vocational education. This implies a ratio of 1 technician with specialized education and 2 skilled workers for every two engineers. It is assumed that there are some works that do not requiring technicians and skilled workers.

Comparing the personnel requirements for the water sector's larger measures to be implemented during 2009-2015 with the presently available personnel resources the following may be concluded:

1. Hydro-construction engineers: An additional 206 (597-391) will be required. It is considered possible to complement the present number with graduates from universities abroad and with water supply and sanitation engineers who have not been included in this survey. However it is important to maintain an average number of 15 specialists graduating from the domestic and foreign universities per year. In parallel the number of graduates seeking employment outside the water sector needs to be reduced, possibly by improving employment conditions.

   With respect to hydro-technicians with specialized vocational education there seems to be a surplus of 30 (282-312) workers. However it should realized that the resources are an estimate. Since 15 years there has not been any training of hydro technicians with specialized vocational education, and the youngest of them must have passed the age of 35. Therefore there is an urgent need to train an average of 21 specialists per year starting from 2010.

2. There is an apparent shortage of 116 (348-232) hydro-geologists. It is assumed possible to fill this immediate gap with graduates from universities abroad. The training of hydro-geologists may be continued at the current rate. The number of hydro-geologists with specialized vocational education is 143 (455-312) short of the requirements. Hence there is a need to train an average of 20 persons per year starting from 2010.

3. There is a shortage of 51 (188-137) geophysicist. Therefore, it is necessary to train an average 17 geophysicist per year.

4. A huge shortage of 213 (295-82) hydrologists is observed. There is a need to further study the actual demand for hydrologists and train an average of 25

specialists per year while reducing the number of graduates leaving the water sector.

5. An estimated 119 ecological engineers are required. This would be the basis to determine in detail the number of specialists to be trained in the future.
6. The agronomists for the irrigated cropping industry are employed basically in the operation of the irrigated farms. For this reason, it is considered that they are ill-suited for monitoring and creation works. It may be necessary to reconsider and redesign the training courses for this profession.
7. There is an estimated shortage of 290 (1477-1187) the skilled workers. There is a need study the training of skilled workers and determine specializations and number of workers to be trained henceforth.

Considering the above, the professional engineers and other technical workers except the hydro-technicians with specialized vocational education are more likely to be in short supply, thus the training of these specialists demands urgent attention.

5. Conclusions and suggestions regarding human resources and capacity building in the water sector

Addressing the issue of the water sector's human resources in the "Strengthening Integrated Water Resources Management in Mongolia" project is an innovative and important step for the development of the larger projects for the appropriate use of water resources and the preparation of the national and basin plans. In previous development plans for Mongolia's water sector no attention was given to what kind and what number of human resources would be needed to adequately address the issues. On the basis of this assessment we can now already foresee a potential shortage of water sector specialists that may threaten the successful solving of the issues in the water sector.

It is a bitter truth that the collapse of the water sector public management at the end of the 1980s and the successive changes of Mongolia's socio-economical system have resulted in a weakening of the water sector's duties and responsibilities and a consistent staffing policy has disappeared completely. This caused great difficulties in determining the location, development level and capacity of the current human resources.

To better ensure an adequate source of human resources for the water sector the following suggestions are made:

1. With respect to ensuring continued availability of high quality human resources:
   - Universities, colleges and schools would be required to maintain the quality of their education and training to meet international standards. The Ministry of Science and Education needs to develop and implement procedures to regular monitor the quality of education at the learning institutions and take appropriate action against those learning institutions that do not meet the requirements.
   - Universities, colleges and schools need to review and modernize their education processes to better prepare students for the challenges they will meet after graduation in their professional life in the modern competitive society of a market economy that Mongolia has become and strives for.
   - It is recommended to establish at least three distinct levels of education in each profession: (1) Scientific level education: at universities leading up to BSc, MSc and PhD level graduates (engineers); (2) Diploma college education: training highly qualified technicians; and (3) Vocational education for skilled labourers and artisans. At present some students seem to focus on obtaining a university education (BSc) not taking in to account their learning capabilities rather than training at a college or vocational school. This trend needs to be reversed. Each of the three levels of education should be made attractive to students, which means that they should each offer good career perspectives and students should be discouraged and be prevented from entering universities when not fully qualified or lacking adequate financing; Admission standards for university courses should be tough and strictly adhered to. The modern Mongolian society requires high-quality professionals (at all levels from artisans to PhDs), not just large quantities of professionals.
   - Educational institutes can only deliver highly qualified professionals when they are equipped with highly qualified teachers and trainers as well as proper

training facilities including well stocked libraries with the latest publications in each field of science, properly laboratories with the latest instruments, adequately equipped classrooms with modern teaching tools such as overhead projectors, etc. Budgets should be available for universities, colleges and schools to continuously update their education facilities. Options for private sector (co-) financing should be opened.

- To ensure professionals continuously update themselves with the latest techniques and scientific developments regular refresher courses should be on offer.
- To regulate the inflow of students to largely reflect the need of society for specific professionals, the concept of *Numerus clausus* (fix (limit) the number of students to be admitted for a specific course) may be introduced for courses that attract more students than society can absorb. The study in subjects with a shortage of professionals could be made more attractive by (temporary) lowering the tuition fees for such studies or otherwise offering bonuses to students choosing that particular subject.

2. With respect to attracting professionals to work in the water sector:
   - Water sector organisations should prepare and offer career opportunities for water professionals. Government organisations and institutions in particular need to offer work conditions that include salaries, fringe benefits and career perspectives that can compete with the private sector.
   - The hiring of professionals in the water sector, whether by government organisations or in the private sector needs to be on merit and the hiring process needs to be competitive and transparent and be freed from any form of nepotism or any other form of favouritism so as not to discourage any person from entering the water profession.
   - Professionals should be facilitated and stimulated to take refresher courses to ensure they remain up to date in their profession.

6. 2008–2012 activities conducted within "Building Human Resources" of the project "Strengthening Integrated Water Resources Management in Mongolia"

The following activities are being conducted in order to prepare water sector experts and improve their capacity within the framework of "Strengthening Integrated Water Resources Management in Mongolia" project. It plays a key role to implement integrated water resources management. They include:

1. 1 credit IWRM bachelor and 2 credit master's programs were developed and approved. They have been taught in water-field classes of NUM, MUST and MSUA since 2009.
2. "Water Management" joint master program with professional index E341800 was developed in NUM, MUST and MSUA. It was approved by 322nd order of the 2nd of September, 2011 of Minister of Education, Culture and Science. Its implementation commenced in academic years of 2011-2012. Some 28 young experts of 17 water sector organizations have been involved. The following people are studying with scholarships: Some 13 people at NUM, 8 people at MUST and 7 people at MSUA.

Figure 17. Water management joint master's program opening

3. Within the framework of project scholarship, one MSc and one PhD students are studying at UNESCO-IHE Institute of Water Education in Delft city of the Netherlands, one PhD student is studying at Institute of Environmental

Research of Spain and 1 MSc student at Seattle University, USA. They are studying in the field of water management.

4. Between 2010 and 2012, the following students successfully graduated and are currently working in water sector organizations: 2 MSc students from the UNESCO-IHE Institute of Water Education in Delft, the Netherlands; 1 MSc student from Kristianstad University of Sweden; 6 students completed their 10-month diploma course at the Asian Institute of Technology in Thailand.

5. In support of training water management experts at NUM, MUST and MSUA, the project funded the procurement of selected textbooks, software and research equipment. In addition, young teachers have been involved in study tours, short training and PhD programs.

6. Between 2009 and 2012, under the project, some 60 persons from the water sector received short trainings, fellowships, and study tours on aspects of water management in the Netherlands and other countries.

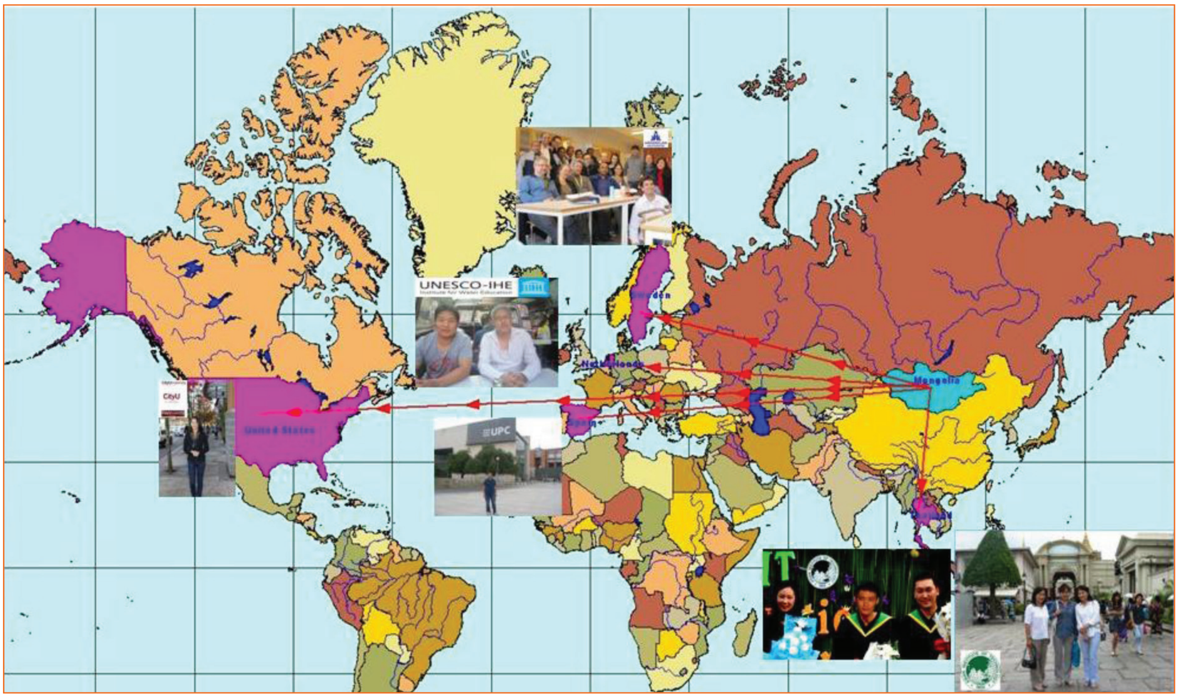

Figure 18. Scope of water management scholarships

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ANNEXES

Annex 1. Survey on the water engineers graduated from the MUST since 1966

(Hydro-construction, water supply)

March, 2009

№	Graduation date	Male	Female	Working on the profession	Working in the public sector	Director, deputy director and senior engineer of the company	Running the private business (non-professional work)	Working or living abroad	Died	Went on to pension (Incapable)	The number of the graduates
1	1966	19	-	-	-	-	-	-	14/73.7	5	19
2	1967	28	1	-	3	-	8	-	10/34.5	8	29
3	1971	8	2	2	1	-	4	-	2	1	10
4	1972	10	-	6	1	-	1	-	2	+	10
5	1973	11	3	3	1	1	7	-	2	-	14
6	1974	14	3	7	2	-	5	-	3	-	17
7	1975	15	1	8	2	-	4	-	2	-	16
8	1976	12	-	4	3	1	1	-	3	-	12
9	1977	16	4	7	2	2	6	-	3	-	20
10	1978	18	4	7	3	2	6	-	4	-	22
11	1979	22	10	7	6	1	14	-	4	-	32
12	1980	20	5	3	4	6	10	-	2	-	25
13	1981	14	11	7	-	2	12	-	3	1	25
14	1982	22	18	8	3	2	23	1	2	1	40
15	1983	15	7	4	4	1	11	-	2	-	22
16	1984	22	10	6	2	1	20	1	2	-	32
17	1985	13	16	5	2	2	20	-	-	-	29
18	1986	18	12	3	1	1	21	1	3	-	30
19	1987	11	12	4	-	1	17	-	1	-	23
20	1988	15	11	5	1	1	14	2	3	-	26
21	1989	13	4	3	1	2	11	-	-	-	17
22	1990	8	8	3	-	1	11	1	-	-	16
23	1991	9	5	6	1	1	3	2	1	-	14
24	1992	7	7	2	1	-	9	2	-	-	14
25	1993	8	4	4	-	1	5	2	-	-	12
26	1994	5	1	1	1	-	3	1	-	-	6
27	1995	6	-	1	-	1	4	-	-	-	6
28	1996										
29	1997	3	3	1	-	-	4	1	-	-	6
30	1998	8	2	3	-	-	7	-	-	-	10
31	1999	8	7	7	-	-	5	3	-	-	15
32	2000	5	4	3	1	-	4	-	1	-	9
33	2001	3	6	6	-	-	2	1	-	-	9
34	2002	4	6	3	-	1	6	-	-	-	10
Sum of 33 years		410	187	139	46	32	279	18	68	16	597
Aged more than 60		65	3	8	5	-	13	-	28	18	68
Aged less than 59		345	184	131/24.8	41/7.8	32/5.9	265/50.0	18/3.4	41/7.8	2/0.3	529
Aged less than 50		203	143	78/22.5	18/5.2	16/4.6	201/57.8	18/5.2	14/4.3	1/0.3	346

№	Graduation date	Male	Female	Working on the profession	Working in the public sector	Director, deputy director and senior engineer of the company	Running the private business (non-professional work)	Working or living abroad	Died	Went on to pension (Incapable)	The number of the graduates
35	2003	3	8	4	-	-	7	-	-	-	11
36	2004	No graduation									
37	2005	3	5	4	-	-	4	-	-	-	8
38	2006	3	4	3	-	-	3	1	-	-	7
39	2007	17	17	19	-	-	15	-	-	-	34
40	2008	9	16	8	-	-	16	1	-	-	25
Total		35	50	38	-	-	45	2	-	-	85
Sum 38 years		445 / 65.2	237 / 34.8	117 / 26.0	46 / 6.7	32 / 4.7	323 / 47.4	20 / 2.9	68 / 10.0	16 / 2.3	682
Aged less than 50 Figures and percentage		238 / 55.2	193 / 44.8	116 / 26.9	18 / 4.2	16 / 3.7	246 / 57.2	20 / 4.6	14 / 3.2	1 / 0.2	431

Note:

1. *When assuming the graduates in 1972 were aged 23 on average, they would reached 60 in 2009. Those who graduated after that time are aged less 59.*
2. *When assuming the graduates in 1982 were aged 23 on average, they would reach 53 in 2012 and be able to legally work for another 2-7 years.*
3. *Over 200 people who graduated from the MUST as hydro-construction engineers, water supply, and hydroelectric power station are employed outside the water sector. They account for 63% of the graduates.*
4. *78 or 23,6%of 330 engineers aged over 50 work in the their profession, 18 or 5,5% work in the public sector, 16 or 4,8 %t serve as director, deputy director or senior engineer in a company, 200 or 60,6% are employed outside the water sector and 18 or 5,5% work and live abroad.*

Annex 2. The number of trainees studying in MUST, NUM and MSUA on the profession of water resources in 2008-2009 academic years

Courses	Water construction	Water resource, ecology	Hydro geologists	Hydrologists	Agronomists for the irrigated cropping industry	Total
I	25	26	24	21	10	106
II	18	18	-	18	3	57
III	13	17	-	13	6	49
IV-V	16	21	21	18	6	82
Total	72	82	45	70	25	294

Annex 3. The graduates from the MUST in 1971-2008

April, 2009

№	On five years	The number of engineers working currently and five years average	Of which				Growth (+) and decline (-) for the period of five years
			Working in organizations and economic entities		Running non-professional work and services		
			numbers	%	numbers	%	
a)	Survey on specialists graduated as the water construction engineers						
1	1971 1975	55/11	34	61.8	21	38.2	-
2	1976 1980	95/19	58	61.1	37	38.9	+40/8
3	1981 1985	135/27	49	36.3	86	63.7	+40/8
4	1986 1990	101/20	27	26.7	74	73.3	-34/7
5	1991 1995	44/9	20	45.5	24	54.5	-57/11
6	1996 2000	35/7	15	42.9	20	57.1	-9/2
7	2001 2005	37/7	18	48.6	19	51.4	+2/0
8	2006 2008	64/21	30	46.9	34	53.1	+27/9
Total		566/121	251	44.3	315	55.7	-9
38 years average		15	7	46.7	8	53.3	+6.1-(0.6) -6.1 -(0.6)
b)	Survey on specialists graduated as the hydro-geologists						
1	1981 1985	70/14	59	84.3	11	15.7	-
2	1986 1990	81/16	69	85.3	12	14.8	+11/2
3	1991 1995	26/5	16	61.3	10	38.5	-55/11
4	1996 2000	9/2	8	88.9	1	11.1	-17/3
5	2001 2005	17/3	17	100.0	-	-	+8/2
6	2006 2008	16/5	14	87.5	2	12.5	-1/0
Total		219/45	183	83.6	36	16.4	-54
28 years average		8	6.5	81.2	1	18.8	+1.9-(3.7) -5.6 -(3.7)
c)	Survey on specialists graduated as the geophysicists						
1	1998 2000	22/7	17	77.3	5	22.7	-
2	2001 2005	50/10	36	72.0	14	28.0	+28/6
3	2006 2008	34/11	28	82.4	6	17.6	-16/3
Total		106/10	81	76.4	25	23.6	+12
11 years average		9.6	7.4	77.1	2.2	22.9	+5.6+(0.3) -5.3 +(0.3)

Annex 4. The specialists graduated from the MUST as the water construction engineers in 1971-2008, classification of 38 years of that historical condition into 4 stages. (Figure 4)

Condition	Period I: 1971-1985	Period II: 1986-1995	Period III: 1996-2005	Period IV: 2006-onwards
1. Public management and organization of the water sector	Only the State Great Khural and the Ministry of Water were implementing water sector policy in its entirely. This stage, may be said, was the intensive development period of Mongolia's water sector. Then the water sector management was distributed broadly nationwide.	The Water Minister was dismantled. Such organizations as the Water sector department and Water corporation at the Ministry of Food and Agriculture were changed and the Public management started to weaken. The social system of the country changed following the New Constitution. Poorly organized privatization allowed the water sector organizations to disintegrate.	It was the period of paying more attention to privatization. As a result, the State administration was changed and the water sector management unit in the Ministry of Food and Agriculture was abolished. The public management of Mongolia's water sector was lost completely. However, in 1998 the National Security Council discussed the water issues, and then the first National Water Program was adopted in 1999. The Law on Water Resources was renewed in 2004. After a year, the Water Authority Agency was established under the Ministry of Environment.	The Ministry of Nature and Environment and its Water Authority Agency are responsible for the water policy of Mongolia. Presently, 5-6 Ministries as well as some NGOs are in charge of the water policy of the country. However, there is lack of coordination as well as absence of an integrated approach, planning and shortage of qualified personnel.
2.The amount of investment and performed work of the water sector	Investment from the State budget in the water sector reached its peak in this period. For example in 1975 the number of engineered water points shot up to 14600. 73% of the irrigated pastureland was provided with water from these points. The operational level of water-holes was 92,5% and of water system 72,0 %	Investment from the State budget in the water sector decreased sharply. Water sector construction works stagnated and its personnel started to disperse.	The investment from the State budget into the water sector stopped completely. However, foreign countries and international organizations started to invest in the water sector of Mongolia from 1996 onwards. The Government of Mongolia began investing in the sector again from 2004. As a result the activities in the water sector were revived again in the form of repairing of wells. 2942,0 mln tugrigs were invested for repairing of wells, 446,0 mln for digging a new wells, 3507,0 mln for repairing the irrigation systems during 1998-2005. During this period 1699 water- holes were repaired and the irrigation systems covering 5100 ha were restored.	3304,0 mln tugrigs was invested for repairing the wells and 992 wells were repaired in 2006-2007, whereas 1915 wells were dug at a cost of 19656,0 mln tugrigs in 2006-2008. During that period, irrigation systems covering 10,4 thousand ha were restored at the costs of 7555,0 mln and irrigation systems covering 8400 ha were built anew with an investment of 33025,0 mln.
3. Demand and requirement of water construction professionals	Demand for engineers and other technical workers of water construction were high as a result of definitive public management for the water sector and sufficient investment. At that period, the majority of water construction engineers were employed in over 50 organizations and economic entities including the water sector departments, water and public utility units in Ulaanbaatar and 18 aimags.	Water sector activities were stopped basically in all parts except the water supply in urban areas and the demand for personnel severely declined. Unemployment was rampant among the water construction engineers.	In connection with that, foreign countries and international organizations along with the Government of Mongolia began to make investments in the water sector; demand for personnel recovered. However, most experienced engineers had moved to the private sector and others had reached retirement age.	The need for water construction engineers increased due to the growth of work, type and size in the water sector. It is important to keep it at this level and restore the specialized vocational schools.

4. Planning of water sector's personnel requirements	The Ministry of Water, The State Planning Commission, the Government and the State Great Khural discussed and guaranteed step by step the need and demand for the specialists and professional workers with higher and specialized vocational education of water construction. Then the universities, colleges and specialized vocational schools trained the personnel according to the decisions of the above organizations.	The planning of personnel for the water sector stopped as some organizations for planning were dismantled and the system of a centralized planned economy was abolished.	All specialized vocational schools were closed as all educational establishments were transferred to the paid training system and the centralized planning system had been eliminated completely. Nowadays, the UST is providing usually the need and demand for the water construction engineers. It means that this planning is transferred now to the professional faculty and department.	In consultation with the Ministry of Education, Culture and Science the universities determine the type of water construction profession, the number of the entrants and graduates, and their distribution.
5. The training of the water sector personnel	It was the period of that water construction engineers, technicians and professional worker were eductated in the largest numbers if calculated by the rate of that time. These specialists are being educated for 42 years since 1966.	The education of personnel in general declined abruptly as a result of abolishing the public management, changing the personnel planning and decreasing the investment.	In connection with that the need and demand for personnel are restored. There is a indication of increasing education of hydro-construction engineers. The water technical training school in Uvurkhangai and the water vocational training school in Darkhan were privatized and subsequently closed.	On average 22 people graduated from the University as hydro-construction engineer per year. 13-16 years have passed since the education of hydro-technicians with specialized vocational education and professional workers was stopped. The records of trainees abroad are mostly lost.

Annex 5. Survey on those who defended the master degree in the field of water in 2002-2008

April, 2009

№	Field of profession	Male	Female	Total	Working on own profession	Working in the public sector	Director, deputy director of company	Running private business	Went abroad
1	Hydro construction	5	3	8	8	-	-	-	-
2	Water supply, Water sewerage	9	3	12	9	-	3	-	-
3	Hydrogeology	7	8	15	8	4	-	1	2
4	Hydrology	2	1	3	3	-	-	-	-
5	Agronomy for the irrigated cropping industry	1	2	3	3	-	-	-	-
	Total, figure percentage	24/58.5	17/41.5	41	31/75.6	4/9.7	3/7.3	1/2.5	2/4.9

Annex 6. Survey of specialists defended the academic thesis after graduation from the MUST as the engineers on water construction, hydropower plant, water resources and ecology

March, 2009

№	Full name of Doctors	Birth date, age and gender	Date on which degree is defended, age	Theme of the academic thesis
1	Tsedengiin Sosorbaram	1955, 54 male	1994, 39	Mathematic modeling the dispersing process of dirty substances into the surface and underground water.
2	Tsanbiin Batdorj	1953, 56 male	1996, 43	Upgrading the construction part and design for taking water from the mountain rivers of Mongolia.
3	Shirchingiin Baranchuluun	1954, 55 male	1996, 42	Watering regime and water consumption for fodder Lucerne grown in the central cultivation zone.
4	Luntegiin Janchivdorj	1950, 59 male	1998, 48	Appropriate regime of soil humidity for planting Sugar Beet in the central cultivation zone of Mongolia.
5	Bazarjaviin Bunchingev	1970, 39 female	2005, 35	Applibility of artificial. Neural networks for investigating shortterm developments of near-shore morpology
6	Mongoliin Dugarmaa	1958, 51 female	2006, 48	Comparative research on potato watering methods.

Annex 7. Survey on engineers graduated from the MUST as the hydro geologists since 1978

March, 2009

№	Graduation date	Male	Female	Working on the profession	Working in the public sector	Director, deputy director and senior engineer of the company	Running the private business (non-professional work)	Working or living abroad	Died	Went on to pension (Incapable)	The number of the graduates
1	1978	7	3	2	-	1	2	-	2	3	10
2	1979	14	2	5	1	1	4	-	3	2	16
3	1980	12	11	4	6	4	4	-	3	2	23
4	1981	10	8	7	3	3	1	-	3	1	18
5	1982	12	13	9	3	5	5	-	2	1	25
6	No graduation										0
7	1984	10	13	7	6	1	5	2	2	-	23
8	1985	13	5	6	3	6	-	2	1	-	18
9	1986	15	11	11	7	3	1	2	2	-	26
10	1987	14	6	11	4	4	-	-	1	-	20
11	1988	9	4	5	2	1	4	1	-	-	13
12	1989	7	4	5	1	2	2	-	1	-	11
13	1990	13	8	4	6	3	5	1	2	-	21
14	1991	14	9	3	6	1	9	2	2	-	23
15	No enrolment and graduation										0
16	No enrolment and graduation										0
17	1994	2	3	-	3	1	-	1	-	-	5
18	1995	2	1	2	-	-	1	-	-	-	3
19	1996	1	3	-	2	-	-	2	-	-	4
20	No enrolment and graduation										0
21	No enrolment and graduation										0
22	1999	-	3	1	1	-	1	-	-	-	3
23	2000	2	2	2	2	-	-	-	-	-	4
24	No enrolment and graduation										0
25	2002	2	7	1	1	-	-	1	-	-	3
26	2003	3	3	3	-	-	-	3	-	-	6
27	2004	3	4	4	2	-	-	1	-	-	7
28	2005	4	2	2	4	-	-	-	-	-	6
29	2006	3	2	3	-	-	2	-	-	-	5
30	2007	4	3	6	-	-	-	1	-	-	7
31	2008	3	2	5	-	-	-	-	-	-	5
Sum		179	126	108	63	36	46	19	24	9	305
Graduation since 1982, Figure percentage		136 / 57.1	102 / 42.9	90 / 37.8	53 / 22.3	27 / 11.3	35 / 14.7	19 / 8.0	1.3 / 5.5	1 / 0.4	238

Note:

1. *If suppose they were aged on average 23 in 1978, in 2012 they will be 57.*
2. *If suppose the graduates after 1982 were aged then on average 23, they will be aged less than 53 in 2012.*
3. *(132+102)= 238 engineers have been prepared since 1982. As of 2009, 237 of them are alive.*

Annex 8. Survey on specialists who defended the academic thesis in the field of hydrogeology from MUST

March, 2009

№	Full name of Doctors	Birth date, age and gender	Date on which degree is defended, age	Theme of the academic thesis
1	Dechinlkhundeviin Dorjsuren	1967, 42 male	1995 28	Evaluation for Geological environment of Ulaanbaatar
2	Magsaryn Myagmarjav	1954, 55 male	1996 42	For issues of statistical appraisement for the sessile ground distributed through Orkhon river basin.
3	Ayushiin Tuvdendorj	1955, 54 male	2000 45	Underground water formation and specialty in Balgas Ulaan nuur lake basin.
4	Jantsansambuugiin Batsuren	1959, 50 female	2000 41	Some quality of engineering geology for swelled soil distributed in Mongolia.
5	Demchigiin Oyun	1967, 42 female	2001 34	Specialty of technogen regime of underground water in the Baganuur coal-mine.
6	Barsiin Ariunaa	1974, 35 female	2005 31	Effectiveness of recovery for geological environment destruction.
7	Munkhoogiin Ulziibat	1966, 43 male	2007 41	Tectonic and seismological research on CHUI earthquake occurred in 2003.
8	Nemeriin Buyankhishig	1968, 41 female	2008 40	Modelling changes of hydro geological condition at the central source of Ulaanbaatar water supply.

Annex 9. Survey on engineers graduated from the MUST as the geophysicists since 1998

March, 2009

№	Graduation date Years of graduation	Male	Female	Working on the profession	Working in public sector	Director, deputy director and senior engineer of the company	Running private business	Went abroad	Died	Went on to the pension (Incapable)	The number of graduates
1	1998	6	3	3	1			3	2		9
2	1999	9	4	5	1	1	4	2			13
3	2000	4	4	6	-		1	1			8
4	2001	4	3	3			4				7
5	2002	13	4	9	3		3	2			17
6	2003	9	2	5	2		3	1			11
7	2004	5	1	2		1	2	1			6
8	2005	8	6	10	1		2	1			14
9	2006	7	4	7	2		1	1			11
10	2007	5	6	7	2		2				11
11	2008	7	6	7	3		3				13
Total of 11 years		77 64.2	43 35.8	64 53.3	15 12.5	2 1.7	25 20.8	12 10.0	2 1.7	-	120

Note:

1. *If suppose the graduates in 1998 were aged then on average 23, they will reach 37 in 2012. The graduates after that time must be aged 27-37.*
2. *The geophysicists graduated from the MUST (120 people) are all younger and about 100 of them are being considered as resource of engineers.*

Annex 10. Survey on engineers graduated from the NUM as the hydrologists since 1995

March, 2009

№	Graduation date Years of graduation	Male	Female	Working on the profession	Working in public sector	Director, deputy director and senior engineer of the company	Running private business	Went abroad	Died	Went on to the pension (Incapable)	The number of graduates
1	1995	3	7	4	-	-	4	1	1	-	10
2	1996	1	3	3	-	-	-	1	-	-	4
3	1998	3	4	2	-	-	1	4	-	-	7
4	2001	4	10	7	-	-	5	2	-	-	14
5	2005	5	7	8	-	-	4	-	-	-	12
6	2006	8	11	4	-	-	15	-	-	-	19
7	2007	1	8	4	-	-	5	-	-	-	9
8	2008	4	10	2	-	-	12	-	-	-	14
Sum (8 years)		29/ 32.6	60/ 67.4	34/ 38.2	-	-	46/ 51.7	8/ 9.0	1/ 1.1	-	89

Note:
1. *It may be considered that these engineers are people aged 27-41. (88 engineers)*
2. *It is specific that females account for 67,4 percent of overall graduates.*

Annex 11. Survey on engineers graduated from the NUM as the hydrologists in 1995-2008

№	On five years	The number of engineers working currently and five years average	Of which				Growth (+) and decline (-) for the period of five years
			Working in organizations and economic entities		Running non-professional work and services		
			nr	%	nr	%	
1	1995 2005	38/8	24	63.2	14	36.8	-
2	2006 2008	42/14	10	23.8	32	76.2	+4/1
Total		80/16	34	42.5	46	57.5	+4/1
8 years average		10	4	40.0	6	60.0	+4/1

Annex 12. Survey on specialists graduated from the MSUA as the agronomists for the irrigated cropping industry since 2005

March, 2009

№	Graduation date Years of Graduation	Male	Female	Working on the profession	Working in public sector	Director, deputy director and senior engineer of the company	Running private business	Went abroad	Died	Went on to the pension (Incapable)	The number of graduates
1	2005	6	5	5	2	3		1	-	-	11
2	2006	1	-	-	-	-	1	-	-	-	1
3	2007	4	1	-	-	3	2	-	-	-	5
4	2008	2	2	-	-	2	2	-	-	-	4
Sum (4 years)		13 / 61.9	8 / 38.1	5 / 23.8	2 / 9.5	8 / 38.1	5 / 23.8	1 / 4.8	-	-	21

Note: These agronomists are youth and aged 27-30.
38.1 percent of them are females.

Annex 13. Survey on specialists graduated from the MSUA as the agronomists for the irrigated cropping industry in 2005-2008

№	On five years	The number of engineers working currently and five years average	Of which				Growth (+) and decline (-) for the period of five years
			Working in organizations and economic entities		Running non-professional work and services		
			nr	%	nr	%	
1	2005 2008	20/4	15	75.0	5	25.0	-
Total		20/5	15	75.0	5	25.0	-
4 years average		5	4	80.0	1	20.0	-

Annex 14. Estimation on the engineers

№	Profession and movement of professional people		The number of specialists	Of which				Resource
				Male	Female	Working in organization and economic entities	Running non-professional work and services, and to be moved	
1	a) Water construction engineer		566	370	196	251	315/63	314
	Of which	Aged less than 50	396	217	179	150	246/49	199
		Graduate in 2009-2015	105	63	42	53	52/11	64
		Go on to pension (up 2015)	99	85	14	65/19	34/7	26
		Not included in the resources due to other reasons	13	7	6	8	5	13
	Total		559	341	218	231	328	391

№	Profession and movement of professional people		The number of specialists	Of which				Resource
				Male	Female	Working in organization and economic entities	Running non-professional work and services, and to be moved	
2	b) hydro geological engineer		219	146	73	183	36/7	190
	Graduate in 2009-2015		56	39	22	48	8/2	50
	Of which	Go on to pension (up 2015)	10	6	4	8/2	2/10	2
		Not included in the resources due to other reasons	6	3	3	1	5	6
	Total		259	171	88	222	37	232
3	c) Geophysical engineer		106	68	38	81	25/5	86
	Graduate in 2009-2015		70	45	25	55	15/3	58
	Of which	Go on to pension (up 2015)	-	-	-	-	-	-
		Not included in the resources due to other reasons	7	3	4	2	5	7
	Total		169	110	59	134	35	137
4	d) Hydrological engineer		80	26	54	34	46/9	43
	Graduate in 2009-2015		77	25	52	33	44/9	42
	Not included in the resources due to other reasons		5	2	3	2	3	3
	Total		152	49	103	65	87	82
5	e) Agronomist for the irrigated cropping industry		20	12	8	15	5/1	16
	Graduate in 2009-2015		35	22	13	27	8/2	29
	Not included in the resources due to other reasons		2	1	1	1	1	2
	Total		53	33	20	41	12	43
Sum			1192	704	488	693	499	885

Annex 15. Estimation on the specialists with specialized vocational education

№	Profession and movement of professional people		The number of specialists	Of which				Resource
				Male	Female	Working in organization and economic entities	Running non-professional work and services, and to be moved	
1	a) Hydro technician with specialized vocational education		500	300	200	250	250/50	300
	Of which	Graduate in 2009-2015	25x4=100	60	40	50	50/10	60
		Go on to pension (up 2015)	21	12	9	11/3	10/2	5
		Not included in the resources due to other reasons	5	4	1	2	3	5
	Total		574	344	230	287	287	360
2	b) hydro geologist with specialized vocational education		500	300	200	200	300/60	260
	Graduate in 2009-2015		25x4=100	60	40	50	50/10	60
	Of which	Go on to pension (up 2015)	4	2	2	3/1	1/0	1
		Not included in the resources due to other reasons	9	6	3	3	6	9
	Total		587	352	235	244	343	312

Annex 16. Estimation on the professional workers

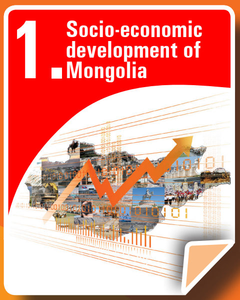
Profession and movement of professional people		The number of workers	Of which				Resource
			Male	Female	Working in organization and econtities	Running non-professional work and services, and to be moved	
Approximate number of professional workers working presently		1800	1080	720	200	1600/320	520
Graduate in 2009-2015		950	570	380	620	330/66	686
Of which	Go on to pension (up 2015)	96	38	58	29/9	67/13	22
	Not included in the resources due to other reasons	41	16	25	17	24	41
Total		2613	1596	1017	774	1839/399	1187

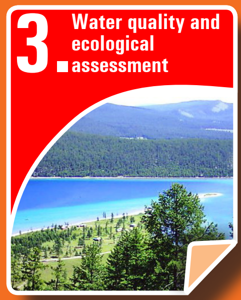
Note: The numbers of people who have education on water, but live and work abroad, they probably do not work in water sector in Mongolia, is presented based on previous research results.

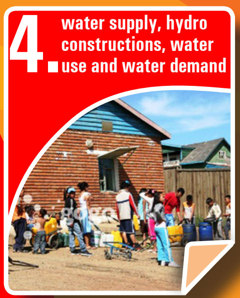
Annex 17. Demand for water sector personnel

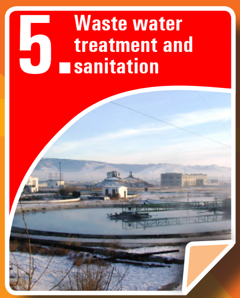
№	Meaning of some issues included in the development goals, direction, comprehensive policies, program and plans approved and ensured by the State Great Khural /Parliament/ and the Government to be implemented until 2015	Required number of specialists						
		Engineer-Hydro technician, hydro technician with vocational education	Hydro geological engineer, technician, hydrologist	Geophysical engineer	Hydrologist, ecologist	Agronomist for the irrigated cropping industry	Professional workers	Total
1	Sep up and operate the basin councils	17/17	10		17/17			78
2	Add the number of the specially protected areas				60			60
3	Operate the organizations and units for the water supply and sanitation sewerage such bigger cities as Ulaanbaatar, Darkhan and Erdenet	128/110	130/75	32	27/20	15	380	917
4	Operate the professional inspection offices in aimags and capital city	27	10		16/22			75
5	Employ the water specialists in soum	235			110			345
6	Add the number of the watch-posts monitoring the surface water				35			35
7	Conduct the search and implement project so as make flow regulation	24/16	8/20		8			76
8	Build the objects for the flow regulation	16/16	8/8		12		320	380
9	Extend and organize the monitoring networks for the underground water		17/160	8				185
10	Extend and organize the monitoring networks for the permafrost water		6/30	4				40
11	Conduct the search and study on the resource for settled area's water supply	31/31	31/31	31	12		95	262
12	Carry out the hydro geological exploitation research and conform the resources in the water source territory of some larger settlements.		7/7	7			21	42

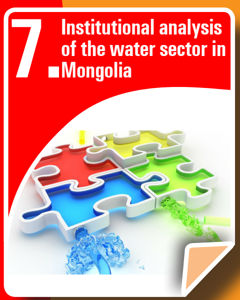
№	Meaning of some issues included in the development goals, direction, comprehensive policies, program and plans approved and ensured by the State Great Khural /Parliament/ and the Government to be implemented until 2015	Required number of specialists						
		Engineer-Hydro technician, hydro technician with vocational education	Hydro geological engineer, technician, hydrologist	Geophysical engineer	Hydrologist, ecologist	Agronomist for the irrigated cropping industry	Professional workers	Total
13	Implement the irrigation search and project works in the 18 objects	20/10	4/3		6	6		49
14	Repair 21 irrigation systems	8/4	4		4	4	25	49
15	Create 99 water pools	5/5			5		15	30
16	Put into operation the new water supply sources at 10 objects in urban and rural areas	5/3	5/5	5			35	58
17	Define anew the water supply sources in the guards, units and frontier posts	3/3	3/3	3			15	30
18	Carry out the water supply search for the UB 3 Power Station and other 2 goal processing factories	-	4/8	4	2	-	20	38
19	Draw newly and restore 800-1000 wells a year		70/40	70			420	600
20	Put into operation 7 hydro-electric power stations	21/21	7/21	7	7		56	140
21	Install the small-scale equipments for wastewater sanitation and drain-pipes	3/6					21	30
22	Build the wastewater collectors in cities and their residential areas	3/6					24	33
23	Take the participation in 17 projects being implemented and financing by the foreign countries and international organizations	51/34	34/34	17	34		30	234
Sum		597/282	348/455	188	295/119	25	1477	3786

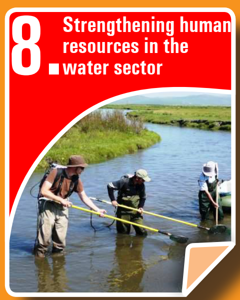












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ISBN 99962-4538-1
9 789996 245381